

### HID & SYSTEM MANAGEMENT PRODUCTS, KEYCODER® FAMILY

**PRELIMINARY**

#### DESCRIPTION

The GreenCoder™ UR5HCFJL is a unique, extremely low-power keyboard encoder that performs optimally in both battery-operated and desktop systems.

The GreenCoder™ scans, debounces, and encodes an 8 X 16\* keyboard matrix, and provides direct drive for 3 LEDs and a bi-directional port for communication with a BIOS-compatible system as well as an external port\* for a keyboard-type device. It fully supports all three PS/2 scan code sets and can implement up to four keyboard layers for full 101/102/104 functionality.

The GreenCoder™ employs a unique Self-Power Management™ method that reduces the power consumption of the keyboard sub-system to an unprecedented minimum, transparently and without user intervention. In "Active" mode, the encoder consumes less than 2 mA (Typ @5V). In "Sleep" mode the encoder consumes less than 2 µA (Typ @5V). The encoder can even nap between keystrokes, and therefore it is rarely active and rarely consumes significant levels of power.

A "stand-by" mode (600 µA Typ @5V) is entered for as long as a periodic task is active. After a programmed period of inactivity the GreenCoder™ gradually dims the LEDs for further power savings.

The GreenCoder™ is ideal for use in battery laptop/notebook designs and Energy Star compliant keyboards.

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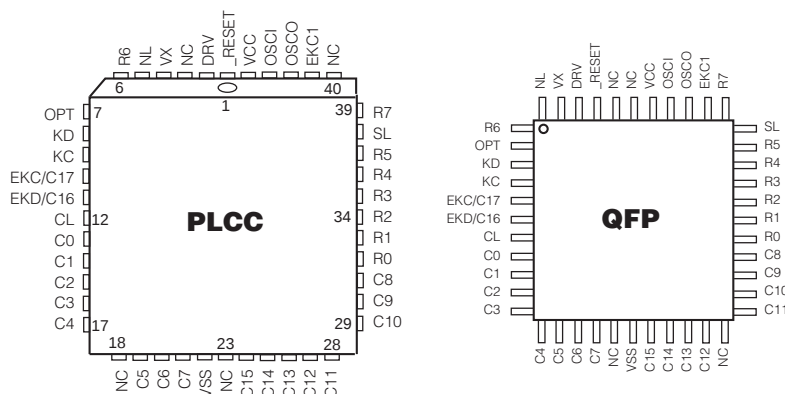
#### FEATURES

- Optimized power-saving operation with idle consumption of less than 2 µA
- Programmable LED dimming for further power savings
- Ready to interface to Fujitsu's 1406, 7211, 7316, 7401, and 7654 keyboards
- 3, 3.3, and 5 Volt operation
- Wakes-up only to respond to an external event and for a minimum period of time (2 mA current consumption)
- Provides interface for external keyboard/keypad or other 8042-compatible device\*
- Energy Star compliant

#### APPLICATIONS

- Laptops / notebooks
- Portable equipment
- Medical instruments
- Palmtops / PDAs

#### PIN ASSIGNMENTS



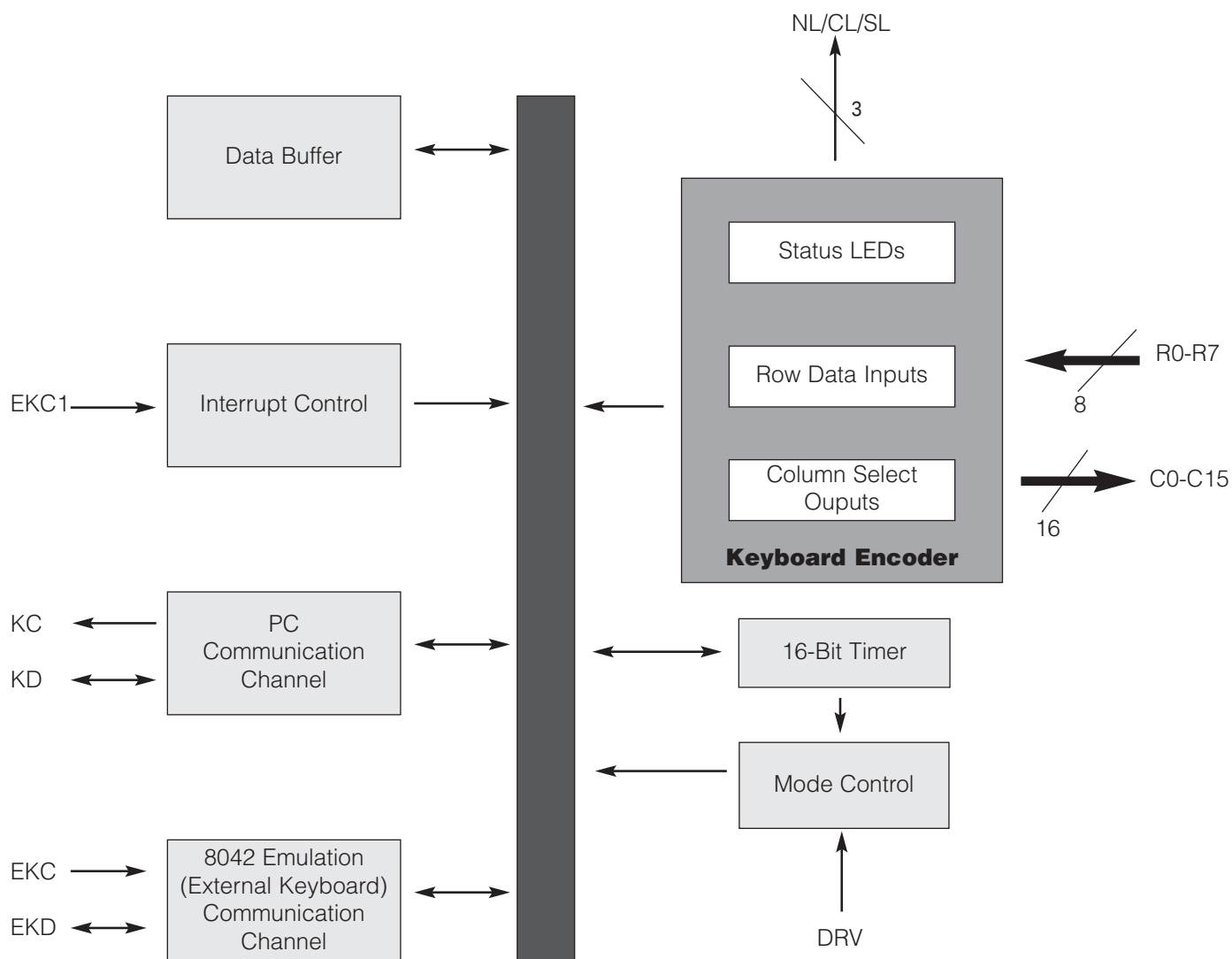
**\*Note:** The UR5HCFJL-7401 scans an 8 x 18 keyboard matrix, and does not provide a port for an external keyboard.

### ORDERING CODE

| Package options      | Pitch   | TA = -40°C to +85°C |
|----------------------|---------|---------------------|
| 44-pin, Plastic PLCC | 1.27 mm | UR5HCFJL-xxxx-FN    |
| 44-pin, Plastic QFP  | 0.8 mm  | UR5HCFJL-xxxx-FB    |

**Note:** "xxxx" = "16" for FKB7316 matrix compatibility, "11" for FKB7211, "06" for FKB1406, "7401" for FKB7401, "7654" for FKB7654

### FUNCTIONAL DIAGRAM



## FUNCTIONAL DESCRIPTION

The GreenCoder™ consists functionally of seven major sections (see Functional Diagram, previous page). These are the Keyboard Encoder, a 16-Bit Timer, the Mode Control Unit, the Data Buffer, the Interrupt Control, the PC Communication Channel and the 8042 Emulation Channel. All sections communicate with each other and operate concurrently.

## KEYBOARD ENCODER

The encoder scans a keyboard organized as an 8 row by 16 column matrix for a maximum of 128 keys. Smaller-size keyboards are supported provided that all unused row lines are pulled to Vcc. When active, the encoder selects one of the column output lines every 512  $\mu$ s and then reads the row input data lines (R0-R7). A key closure is detected as a 0 in the corresponding position of the matrix. A complete scan cycle for the entire keyboard takes approximately 9.2 ms. Each key found pressed is debounced for a period of 20 ms. Once the key is verified, the corresponding key code(s) are loaded into the transmit buffer of the PC keyboard communication channel.

### Scan Code Table Sets

The GreenCoder™ supports all three scan code table sets. Scan code table set 3 allows the user to program individual key attributes such as Make/Break and Typematic or Single-Touch Action. For more information, refer to the IBM technical reference manuals.

## PIN DEFINITIONS

| Mnemonic  | PLCC          | QFP            | Type | Name and Function                                                                                                                                                                     |
|-----------|---------------|----------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| VCC       | 44            | 38             | I    | <b>Power supply:</b> +5V or +3V or +3.3V                                                                                                                                              |
| VX        | 4             | 43             | I    | Tie to Vcc                                                                                                                                                                            |
| VSS       | 22            | 17             | I    | <b>Ground</b>                                                                                                                                                                         |
| RESET     | 1             | 41             | I    | <b>Reset:</b> apply 0V to provide orderly start-up                                                                                                                                    |
| OSCI      | 43            | 37             | I    | <b>Oscillator input</b>                                                                                                                                                               |
| OSCO      | 42            | 36             | O    | <b>Oscillator output</b>                                                                                                                                                              |
| OPT       | 7             | 2              | I    | Used for options selection                                                                                                                                                            |
| DRV       | 2             | 42             | I    | <b>Wake-up line:</b> used for sleep mode                                                                                                                                              |
| KC        | 9             | 4              | I/O  | <b>Keyboard clock:</b> connects to PC keyboard port data line                                                                                                                         |
| KD        | 8             | 3              | I/O  | <b>Keyboard data:</b> connects to PC port data line                                                                                                                                   |
| EKC1      | 41            | 35             | I    | <b>External keyboard clock 1:</b> connects to external keyboard clock line and is used to generate an interrupt for every clock line transmission. For UR5HCFJL-7401 only: tie to Vcc |
| EKC / C17 | 10            | 5              | I/O  | <b>External keyboard clock:</b> connects to external keyboard data line. For UR5HCFJL-7401 only: column 17 select output                                                              |
| EKD / C16 | 11            | 6              | I/O  | <b>External keyboard data:</b> connect to external keyboard clock line. For UR5HCFJL-7401 only: column 16 select output                                                               |
| C0-C4     | 13-17         | 8-12           | I/O  | <b>Column select outputs:</b> select one column                                                                                                                                       |
| C5-C7     | 19-21         | 13-15          | O    |                                                                                                                                                                                       |
| C8-C15    | 31-24         | 26-18          | O    |                                                                                                                                                                                       |
| R0-R5     | 32-37         | 27-32          | I    | <b>Row data inputs</b>                                                                                                                                                                |
| R6        | 6             | 1              | I    |                                                                                                                                                                                       |
| R7        | 39            | 34             | I    |                                                                                                                                                                                       |
| CL        | 12            | 7              | O    | <b>Caps lock LED</b>                                                                                                                                                                  |
| NL        | 5             | 44             | O    | <b>Num lock LED</b>                                                                                                                                                                   |
| SL        | 38            | 33             | O    | <b>Scroll lock LED</b>                                                                                                                                                                |
| NC        | 3, 18, 23, 40 | 39, 40, 16, 22 |      | <b>No connect:</b> these pins are unused                                                                                                                                              |

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

## KEYBOARD ENCODER (CONT'D)

### Embedded Numeric Keypad

The GreenCoder™ implements an embedded numeric keypad. The Numeric Keypad Function is invoked by pressing the Num Lock Key.

### Status LED indicators

The controller provides an interface for three LED shift status indicators. All three pins are active low to indicate the status of the host system (Num Lock, Caps Lock and Scroll Lock) and are set by the system. After approximately a one-minute period of keyboard inactivity, LEDs are dimmed to conserve power. They are set to full brightness again upon a new keystroke.

## N-KEY ROLLOVER

### N-Key Rollover

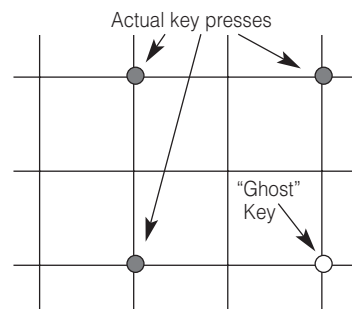
In this mode, the code(s) corresponding to each key press are transmitted to the host system as soon as that key is debounced, independently of the release of other keys.

If a key is defined to be Typematic, the corresponding make code(s) are transmitted while the key is held pressed. When a key is released, the corresponding break code(s) are then transmitted to the host system. If the released key happens to be the most recently pressed, then Typematic action is terminated. There is no limitation in the number of keys that can be held pressed at the same time. However, two or more key closures, occurring within a time interval less than 5 ms, will set an error flag and will not be processed. This procedure protects against the effects of accidental key presses.

## GHOST KEYS

### "Ghost" Keys

In any scanned contact switch matrix, whenever three keys defining a rectangle on the switch matrix are held pressed at the same time, a fourth key positioned on the fourth corner of the rectangle is sensed as being pressed. This is known as the "ghost" or "phantom" key problem. Although the problem cannot be totally eliminated without using external hardware, there are methods to neutralize its negative effects for most practical applications. Keys that are intended to be used in combinations or are likely to be pressed at the same time by a fast typist (i.e., keys located in adjacent positions on the keyboard) should be placed in the same row or column of the matrix whenever possible. Shift Keys (Shift, Alt, Ctrl) should not reside in the same row (or column) with any other keys. The GreenCoder™ has built-in mechanisms to detect the presence of a "ghost" key, thus eliminating the necessity of external hardware.



**Figure 1:** "Ghost" or "Phantom" Key Problem



## 8042 EMULATION CHANNEL

The GreenCoder™ fully emulates a system's keyboard port\*, available to any PS/2 keyboard-type 8042-compatible device. The GreenCoder™ communicates with the external device using clock and data lines connected to the EKC and EKD pins, respectively. The EKC1 pin also connects to the clock line, and interrupts the GreenCoder™ whenever the external device initiates a communication session.

When power is first applied, the GreenCoder™ performs the standard reset sequence with the external device. Data and commands initiated from the external device are buffered in the GreenCoder™'s FIFO along with data from the scanned matrix; all these are presented to the host as if from a single keyboard. Once they are acknowledged, commands and data from the system are relayed to the external device.

## SPECIAL HANDLING

### **Connection of External Device\***

The GreenCoder™ detects the presence of an external device. If an external keyboard or other device was not connected during power-on and is connected at a later time, the GreenCoder™ proceeds with the normal reset routine in order to properly initialize the external device. After communication has been established, the GreenCoder™ continues to check for the presence of the external device. While the external device is connected, the GreenCoder™ does not enter the sleep mode. If the device is disconnected at a later time, the GreenCoder™ becomes aware of it. If a subsequent connection takes place, the GreenCoder™ re-initiates a reset sequence. This unique feature allows the user to connect or disconnect an external device at any time without having to reset the system.

### **Shift Status LEDs**

Shift Status LEDs (Num Lock, Caps Lock and Scroll Lock) indicate the status of the system and are controlled by commands sent from the system. Set/Reset Status Indicator Commands from the system are executed both by the external keyboard and the scanned matrix.

For example, if the user presses the Caps Lock Key on either keyboard, the Caps Lock LED is affected on both keyboards. The LED status indicators are properly set after each new connection of an external keyboard.

**\*Note:** The UR5HCFJL-7401 does not provide a port for an external device.

## PC COMMUNICATION

The GreenCoder™ implements all the standard functions of communication with a BIOS-compatible PC/XT or AT / PS/2 host system. Two lines, KC and KD, provide bi-directional clock and data signals. In addition, the GreenCoder™ supports all commands from and to the system, as described in the IBM technical reference manuals.

The following table shows the commands that the system may send and their values in hex.

| Command                     | Hex Value |
|-----------------------------|-----------|
| Set/Reset Status Indicators | 0xED      |
| Echo                        | 0xEE      |
| Invalid Command             | 0xEF      |
| Select Alternate Scan Codes | 0xF0      |
| Invalid Command             | 0xF1      |
| Read ID                     | 0xF2      |
| Set Typematic Rate/Delay    | 0xF3      |
| Enable                      | 0xF4      |
| Default Disable             | 0xF5      |
| Set Default                 | 0xF6      |
| Set All Keys                |           |
| ■ Typematic                 | 0xF7      |
| ■ Make/Break                | 0xF8      |
| ■ Make                      | 0xF9      |
| ■ Typematic/Make/Break      | 0xFA      |
| Set Key Type                |           |
| ■ Typematic                 | 0xFB      |
| ■ Make/Break                | 0xFC      |
| ■ Make                      | 0xFD      |
| Resend                      | 0xFE      |
| Reset                       | 0xFF      |

**Table 2:** Keyboard commands from the system (AT / PS/2 protocol)

These commands are supported in the AT / PS/2 protocol and can be sent to the keyboard at any time.

The following table shows the commands that the keyboard may send to the system.

| Command                     | Hex Value |
|-----------------------------|-----------|
| Key Detection Error/Overrun | 0x00*     |
| Keyboard ID                 | 0x83AB    |
| BAT Completion Code         | 0xAA      |
| BAT Failure Code            | 0xFC      |
| Echo                        | 0xEE      |
| Acknowledge (Ack)           | 0xFA      |
| Resend                      | 0xFE      |
| Key Detection Error/Overrun | 0xFF**    |

\*Code Sets 2 and 3

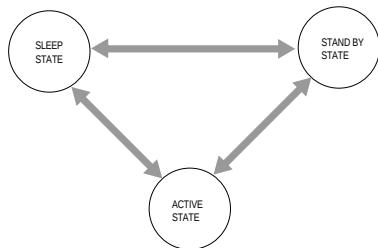
\*\*Code Set 1

**Table 3:** Keyboard Commands to the System (AT / PS/2 protocol)

When an external keyboard is connected, commands from the system will also be directed to the external keyboard. Presence or absence of an external device will not effect the normal operation of the GreenCoder™.

## STATES OF OPERATION

The GreenCoder™ has three states of operation, implemented to minimize the power consumption of the keyboard subsystem. The following diagram illustrates the three states of operation of the GreenCoder™.



**Figure 2:** States of Operation of UR5HCFJL

Most of the time, the GreenCoder™ is in the sleep state. Power consumption in this state is approximately 2  $\mu\text{A}$  at 5 Volts of operation. The GreenCoder™ enters the active state only when there is an event to process, such as a keystroke, a command from the system, or data from the external PS/2-compatible device.

The GreenCoder™ enters and stays in the stand-by state if an external device is connected to the auxiliary port or if one or more LEDs are turned on.

In the stand-by state, the GreenCoder™ consumes approximately 600  $\mu\text{A}$  at 5 Volts. Transition from one state to the other does not require any input from the system.

## USING THE GREENCODER™ FOR SYSTEM MANAGEMENT TASKS

The GreenCoder™ provides an ideal complement to low-power chip sets targeted to the portable and mobile computing market. The GreenCoder™ can be used to handle several system management tasks for small, portable system designs, thus saving space and additional components for the system designer. Such system management tasks include those listed below.

However, since most of the system management tasks are application and hardware-dependent, detailed implementation information is outside the scope of this document. For application examples and sample schematics, contact Semtech technical support.

### **System shut-down/wake-up signal**

The GreenCoder™ can provide the system power management unit with a shut-down/wake-up signal which can be invoked either by a special keyboard combination or after a programmed period of user inactivity.

**Note:** Self-Power Management™ is a feature protected under Semtech Corporation patent and copyright rights. Purchase of any version of the GreenCoder™ conveys a license to utilize the Self-Power Management™ feature only through use of the GreenCoder™ in a PS/2-compatible keyboard subsystem.

## KEY MAP FOR FKB7211 (UR5HCFJL-11)

| Rows (R0-R7) | Columns (C0-C13) |     |        |    |       |       |            |            |                  |            |            |            |        |        |
|--------------|------------------|-----|--------|----|-------|-------|------------|------------|------------------|------------|------------|------------|--------|--------|
|              | 0                | 1   | 2      | 3  | 4     | 5     | 6          | 7          | 8                | 9          | 10         | 11         | 12     | 13     |
|              | LCtrl*           | Esc | Tab    | Fn | LAlt* | Space |            | ` (BkQt)   | Insert           | Delete     | ArrLft     | ArrDn      | LShift | ArrRt  |
|              |                  | F1* | Z      |    |       | X     | C          |            | . (per)<br>Pad . | /          |            | ArrUp      | RShift | End    |
|              |                  | 1   | CapLk  |    |       | V     | B          | N          | M<br>Pad 0       | , (com)    | , (appos)  | Enter      |        | PgDn   |
|              |                  | F2* | A      |    |       | S     | D          | F          | J<br>Pad 1       | K<br>Pad 2 | L<br>Pad 3 | ;<br>Pad + |        | PgUp   |
|              |                  | 2   | 3      |    |       | 4     | T          | Y          | U<br>Pad 4       | I<br>Pad 5 | O<br>Pad 6 | P<br>Pad - |        | BkSpc  |
|              |                  | F4  | F5     |    |       | F6    | F7         | F8         | F9               | F10        | NumLk      | ScrLk      |        | PrtScr |
|              |                  | F3  | %<br>5 |    |       | 6     | 7<br>Pad 7 | 8<br>Pad 8 | 9<br>Pad 9       | 0<br>Pad * | - (dash)   | =          |        | Pause  |
|              |                  | Q   | W      |    |       | E     | R          | G          | H                | [          | ]          | \          |        | Home   |

### \*Note:

Fn + F1 = F11

Fn + F2 = F12

Fn + LCtrl = RCtrl

Fn + LAlt = RAlt

## KEY MAP FOR FUJITSU FKB7316-001 (UR5HCFJL-16)

|              |   | Columns C0-C15 |    |       |       |       |     |       |    |        |        |      |        |        |       |        |       |
|--------------|---|----------------|----|-------|-------|-------|-----|-------|----|--------|--------|------|--------|--------|-------|--------|-------|
| Rows (R0-R7) | 0 | 1              | 2  | 3     | 4     | 5     | 6   | 7     | 8  | 9      | 10     | 11   | 12     | 13     | 14    | 15     |       |
|              | 0 | Space          |    |       | B     |       |     |       | N  | /      |        |      | RAlt   | ArrDn  | ArrRt | ArrLft |       |
|              | 1 | Esc F4         |    | F5    | G     | F6    |     | H     |    | RQ     |        |      | LAlt   |        | ArrUp |        |       |
|              |   | Tab            | F3 | BkSpc | T     | CapLk | RSB | Y     |    | LShift | LBS    | F7   |        |        |       |        |       |
|              | 2 | PgUp           | LQ | F2    | F9    | K5    | F1  | =     | FN | K6     | Dash   |      | F8     | Del    |       | Ins    | Home  |
|              | 3 | LCtrl          | A  | D     | \     | F     | S   | K     | J  |        |        | SCol | L      |        |       |        |       |
|              | 4 | Z              |    | C     | Enter | V     | X   | Comma |    | M      | RShift |      | Period |        | NumLk |        | Pause |
|              | 5 | PgDn           | K1 | K3    | F10   | K4    | K2  | K8    | K7 |        |        | K0   | PK     | PrtScr | F11   | F12    | End   |
|              | 6 | Q              |    | E     |       |       | R   | W     | I  | U      |        |      | P      | O      | ScrLk |        |       |
|              | 7 |                |    |       |       |       |     |       |    |        |        |      |        |        |       |        |       |

### \*Note:

Fn + LCtrl = RCtrl

## KEYBOARD LAYOUT FOR FUJITSU FKB7316-001 (URHCFJL-16)

|                     |             |            |           |           |           |           |            |            |            |            |                |              |                    |                        |                       |                       |
|---------------------|-------------|------------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|----------------|--------------|--------------------|------------------------|-----------------------|-----------------------|
| F00<br>Esc          | F01<br>F1   | F02<br>F2  | F03<br>F3 | F04<br>F4 | F05<br>F5 | F06<br>F6 | F07<br>F7  | F08<br>F8  | F09<br>F9  | F10<br>F10 | F11<br>F11     | F12<br>F12   | F13<br>Num<br>Lock | F14<br>Pause<br>Sys Rq | F15<br>Scroll<br>Lock | F16<br>Pause<br>Break |
| ! E01               | @ E02       | # E03      | \$ E04    | % E05     | ^ E06     | & E07     | * E08      | ( E09      | ) E10      | @ E11      | @ E12          | BS ← E13     | Home E14           |                        |                       |                       |
| 1                   | 2           | 3          | 4         | 5         | 6         | 7 7       | 8 8        | 9 9        | 0 *        | 2          | 2              | BS ←         | Home               |                        |                       |                       |
| D00<br>Tab          | D01<br>Q    | D02<br>W   | D03<br>E  | D04<br>R  | D05<br>T  | D06<br>Y  | D07<br>U 4 | D08<br>I 5 | D09<br>O 6 | D10<br>P - | D11<br>{       | D12<br>}     | D13<br>:/          | D14<br>PgUp            |                       |                       |
| C00<br>Caps<br>Lock | C01<br>A    | C02<br>S   | C03<br>D  | C04<br>F  | C05<br>G  | C06<br>H  | C07<br>J 1 | C08<br>K 2 | C09<br>L 3 | C10<br>; + | C11<br>?       | C13<br>Enter | C14<br>PgDn        |                        |                       |                       |
| B00<br>Shift        | B01<br>Z    | B02<br>X   | B03<br>C  | B04<br>V  | B05<br>B  | B06<br>N  | B07<br>M 0 | B08<br>,   | B09<br>. . | B10<br>/ / | B12<br>0 Shift | B13<br>↑     | B14<br>End         |                        |                       |                       |
| A00<br>FN           | A01<br>Ctrl | A02<br>Alt | ~ A03     | Space A06 |           |           |            | Alt A09    | A10<br>Ins | A11<br>Del | A12<br>←       | A13<br>↓     | A14<br>→           |                        |                       |                       |

## KEY MAP FOR FUJITSU FKB1406 (UR5HCFJL-06)

|              |           | Columns (C0-C13) |          |        |       |    |       |    |    |         |          |          |           |        |       |
|--------------|-----------|------------------|----------|--------|-------|----|-------|----|----|---------|----------|----------|-----------|--------|-------|
|              |           | 0                | 1        | 2      | 3     | 4  | 5     | 6  | 7  | 8       | 9        | 10       | 11        | 12     | 13    |
| Rows (R0-R7) | 0         |                  |          |        |       |    |       |    |    |         |          |          |           |        |       |
|              | 1         | LAlt             | ` (BkQt) |        | LCtrl | FN | Esc   | 1  | 2  | 9/Pad 9 | 0/ Pad * | - (dash) | =         |        | BkSpc |
|              | <i>Fn</i> | RAlt             |          |        | RCtrl |    |       | F1 | F2 | F9      | F10      | NmLk     | BkSp      |        |       |
|              | 2         |                  | \        | LShift |       |    | Del   |    | T  | Y       | U/Pad 4  | I/Pad5   | Enter     | RShift | DArw  |
|              | <i>Fn</i> |                  |          |        |       |    |       |    |    |         |          |          |           |        | PgDn  |
|              | 3         |                  | TAB      |        |       |    | Q     | W  | E  | R       | O/Pad 6  | P/Pad -  | [         |        | ScrLk |
|              | <i>Fn</i> |                  |          |        |       |    |       |    |    |         | Ins      |          | Pause     |        |       |
|              | 4         |                  | Z        |        |       |    | CapLk |    |    | K/Pad 2 | L/Pad 3  | ;/Pad +  | , (appos) |        | UArw  |
| <i>Fn</i>    |           |                  |          |        |       |    |       |    |    |         | PrtScr   | SysReq   |           | PgUp   |       |
| 5            |           | A                |          |        |       |    | S     | D  | F  | G       | H        | J/Pad 1  | //Pad /   |        | LArw  |
| <i>Fn</i>    |           |                  |          |        |       |    |       |    |    |         |          |          |           |        | Home  |
| 6            |           | X                |          |        |       |    | C     | V  | B  | N       | M/Pad 0  | , (com)  | . (per)   |        | Space |
| 7            |           |                  |          |        |       |    | 3     | 4  | 5  | 6       | 7/Pad 7  | 8/Pad 8  |           |        | RArw  |
| <i>Fn</i>    |           |                  |          |        |       |    | F3    | F4 | F5 | F6      | F7       | F8       | Prog      |        | End   |

**Note:** The values obtained when the Fn key is held down are shown in the lines marked "*Fn*" in the table above.

## KEY LAYOUT FOR FUJITSU FKB1406 (UR5HCFJL-06)



# KEY MAP FOR THE GREENCODER™ UR5HCFJL-7654

Columns (C0-C15)

|                                                                                                                                                                                                                                |  | Rows (R0-R7)  |                 |                 |        |        |       |                 |                  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------|-----------------|-----------------|--------|--------|-------|-----------------|------------------|--|
|                                                                                                                                                                                                                                |  | 0             | 1               | 2               | 3      | 4      | 5     | 6               | 7                |  |
| 0                                                                                                                                                                                                                              |  |               |                 |                 |        |        |       |                 | FN               |  |
| 1                                                                                                                                                                                                                              |  | LWin          |                 |                 |        |        |       |                 |                  |  |
| 2                                                                                                                                                                                                                              |  | Tab           | CapsLk          | 1               | S      | Z      | A     | Q               | Esc              |  |
| 3                                                                                                                                                                                                                              |  | RAlt          |                 |                 |        |        |       |                 | LAlt             |  |
| 4                                                                                                                                                                                                                              |  | F1            | F2              | F3              | E      | D      | W     | 2               | X                |  |
| 5                                                                                                                                                                                                                              |  | 8/N8          | 9/N9            | I/N5            | ,      | Space  | K/N2  | U/N4            | M/N0             |  |
| 6                                                                                                                                                                                                                              |  | F6            | 3               | 4               | F      | C      | R     | 5               | F4               |  |
| 7                                                                                                                                                                                                                              |  | F9            | F5              | 6               | V      | B      | G     | T               | F7               |  |
| 8                                                                                                                                                                                                                              |  | F10           | F11             | F8              | N      | H      | Y     | 7/N7            | J/N1             |  |
| 9                                                                                                                                                                                                                              |  | F12           | O/N*            | O/N6            | . / N. |        |       | L/N3            | NumLk/<br>FScrLk |  |
| 10                                                                                                                                                                                                                             |  | Pause         | =               | ]               | \      |        |       | [               | `                |  |
| 11                                                                                                                                                                                                                             |  | BkSp          | DnArr/<br>FPgDn | UpArr/<br>FPgUp | '      | WinApp | Enter | Ins/<br>FPrtScr |                  |  |
| 12                                                                                                                                                                                                                             |  | RWin          |                 |                 |        |        |       |                 |                  |  |
| 13                                                                                                                                                                                                                             |  | RArr/<br>FEnd | LArr/<br>FHome  | Del/<br>FSysReq | / / N/ | ;/N+   |       | P/N-            | -                |  |
| 14                                                                                                                                                                                                                             |  | LCtrl         |                 |                 |        |        |       |                 | RCtrl            |  |
| 15                                                                                                                                                                                                                             |  | LShft         | RShft           |                 |        |        |       |                 |                  |  |
| <p><b>Note 1:</b> The letter N in italics, followed by a number or symbol, indicates that key in Num Case.</p> <p><b>Note 2:</b> The letter F in italics, followed by a key function, indicates that key in Function Case.</p> |  |               |                 |                 |        |        |       |                 |                  |  |



#### IMPLEMENTATION NOTES FOR THE GREENCODER™ UR5HCFJL

The following notes pertain to the suggested schematics found on the next pages.

The built-in oscillator on the GreenCoder™ requires the attachment of a 2.00 MHz ceramic resonators with built-in load capacitors. You can use either an AVX, part number PBRC-2.00 BR; or a Murata part number CSTCC2.00MG ceramic resonator.

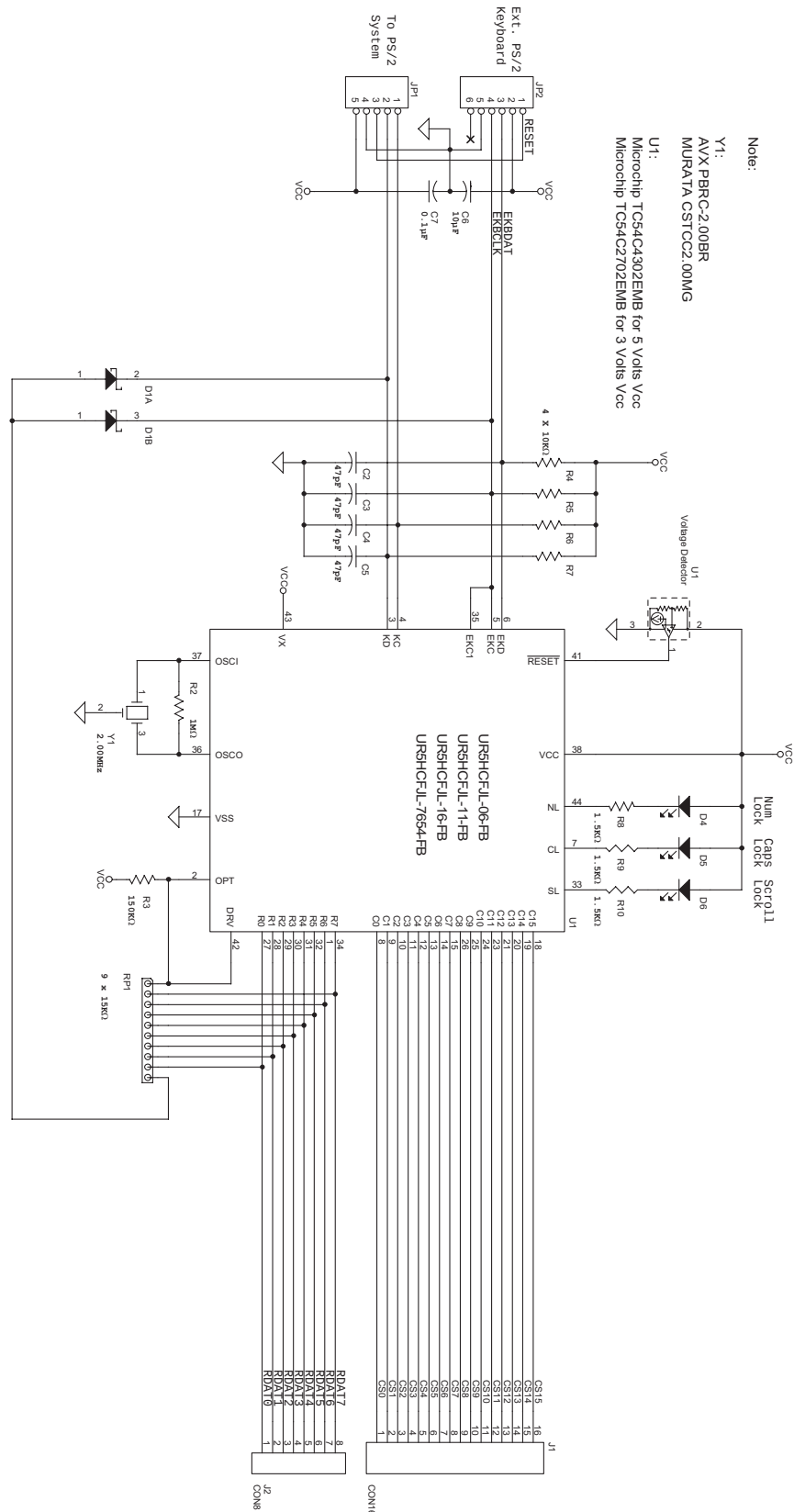
It may also be possible to operate with the 2.00 MHz crystal, albeit with reduced performance. Due to their high Q, the crystal oscillator circuits start-up slowly. Since the GreenCoder™ constantly switches the clock on and off, it is important that the ceramic resonator is used (it starts up much quicker than the crystal). Resonators are also less expensive than crystals.

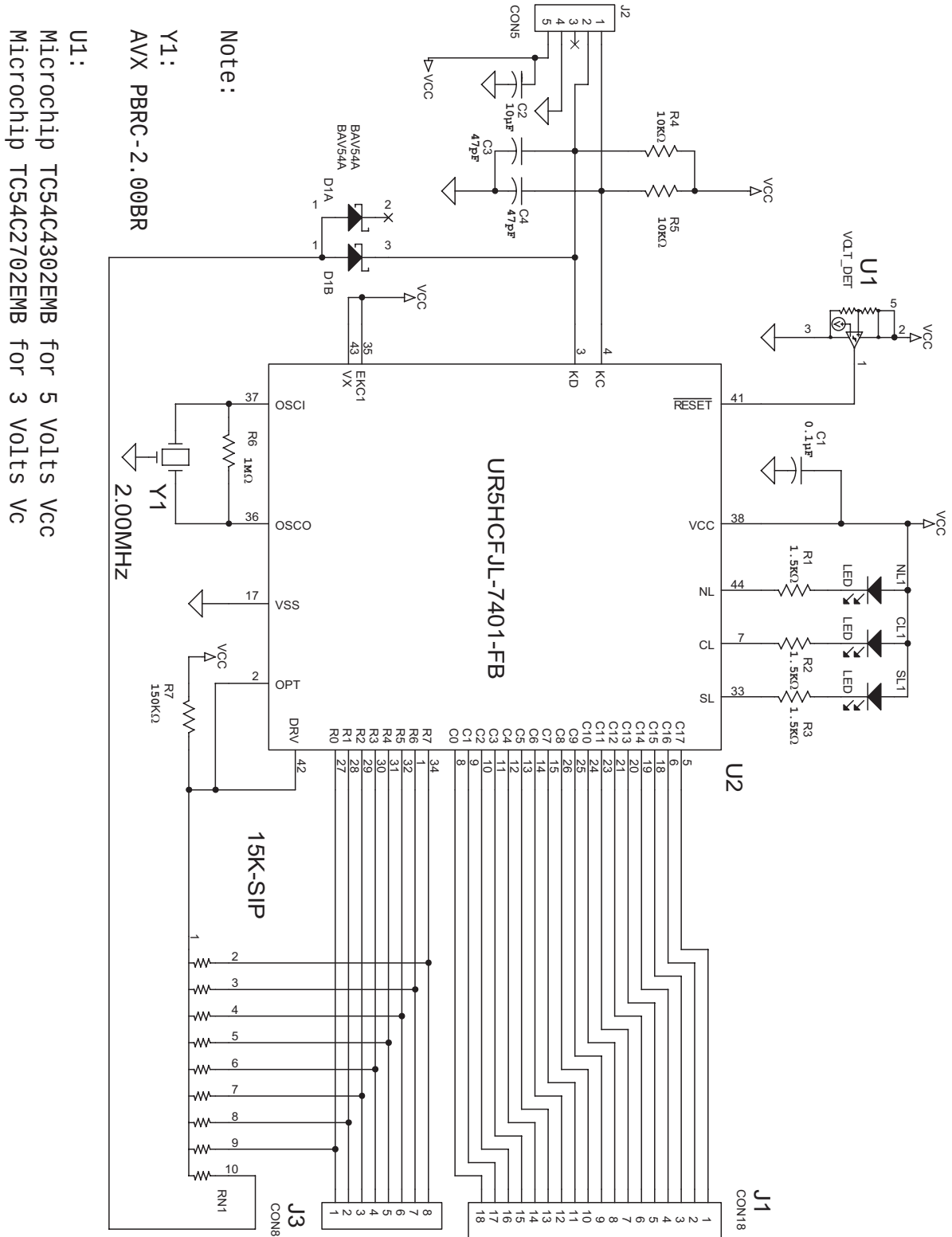
Also, if crystal is attached, two load capacitors (33pF to 47pF) should be added, a capacitor between each side of the crystal and ground.

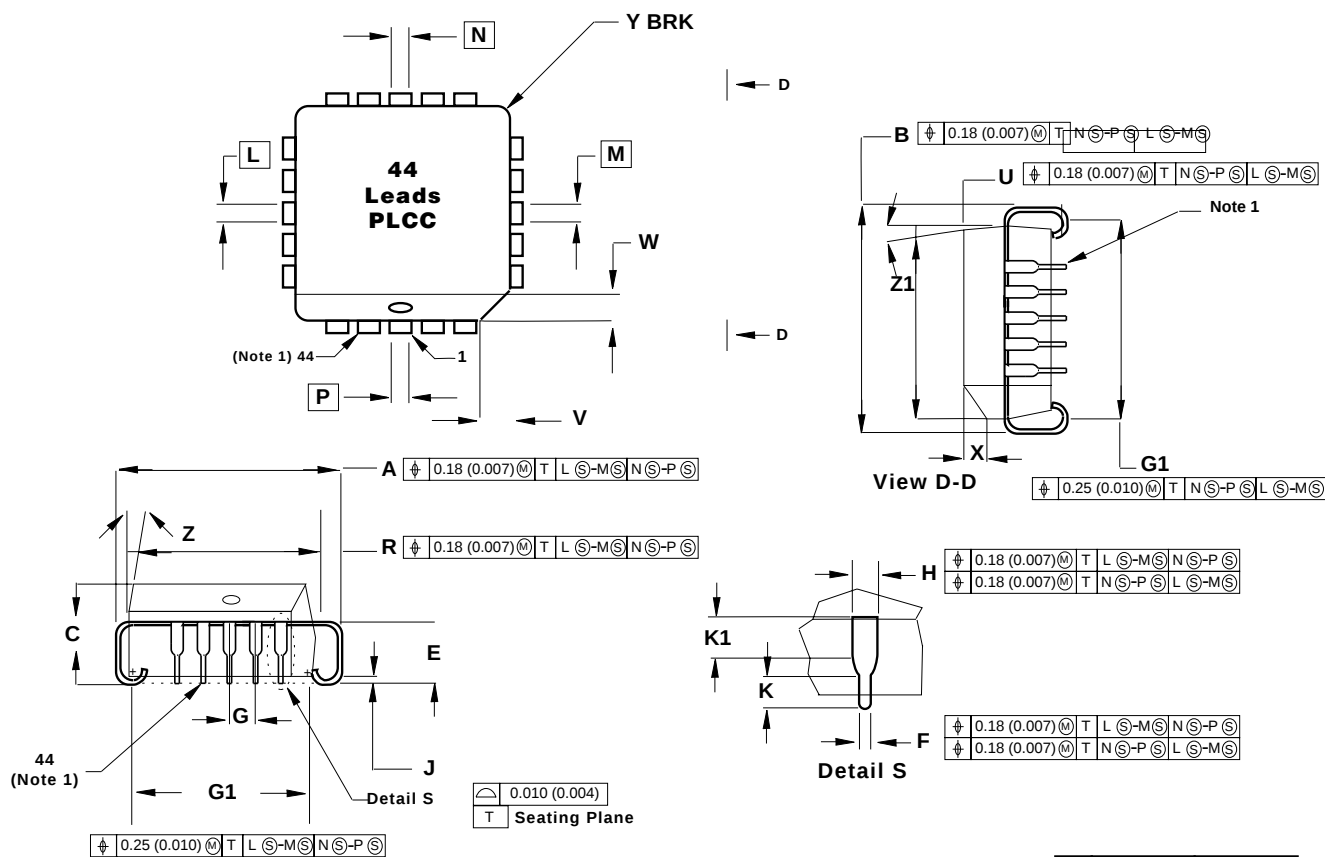
In both cases, using ceramic resonator with built-in load capacitors, or crystal with external load capacitors, a feedback resistor of 1 MegaOhm should be connected between OSCI and OSCO.

Troubleshoot the circuit by looking at the output pin of the oscillator. If the voltage is half-way between supply and ground (while the oscillator should be running), the problem is with the load caps / crystal. If the voltage is all the way at supply or ground (while the oscillator should be running), there are shorts on the PCB.

**Note:** when the oscillator is intentionally turned OFF, the voltage on the output pin of the oscillator is high (at the supply rail).



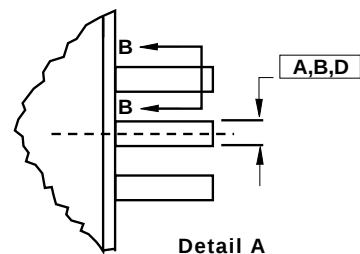
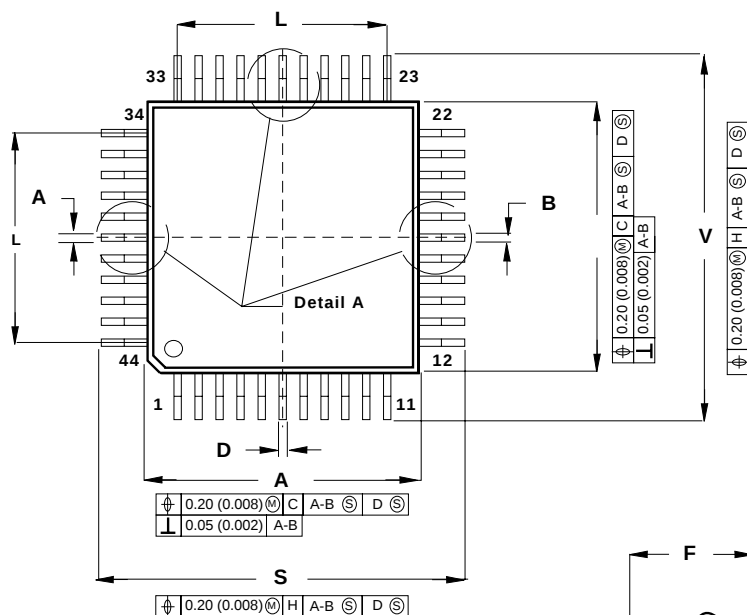




#### Notes:

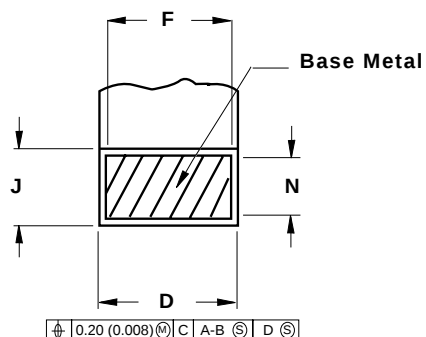
- Due to space limitation, the chip is represented by a general (smaller) case outline drawing rather than showing all 44 leads.
- Datums L, M, N, and P determine where the top of the lead shoulder exits plastic body at mold parting line.
- DIM G1, true position to be measured at Datum T, Seating Plane.
- DIM R and U do not include mold protusion. Allowable mold protusion is 0.25 (0.010) per side.
- Dimensioning and tolerancing per Ansi Y14.5M, 1982.
- Controlling dimension: Inch.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 17.40       | 17.65 | 0.685     | 0.695 |
| B   | 17.40       | 17.65 | 0.685     | 0.695 |
| C   | 4.20        | 4.57  | 0.165     | 0.180 |
| E   | 2.29        | 2.79  | 0.090     | 0.110 |
| F   | 0.33        | 0.48  | 0.013     | 0.019 |
| G   | 1.27 BSC    |       | 0.050 BSC |       |
| H   | 0.66        | 0.81  | 0.026     | 0.032 |
| J   | 0.51        | -     | 0.020     | -     |
| K   | 0.64        | -     | 0.025     | -     |
| R   | 16.51       | 16.66 | 0.650     | 0.656 |
| U   | 16.51       | 16.66 | 0.650     | 0.656 |
| V   | 1.07        | 1.21  | 0.042     | 0.048 |
| W   | 1.07        | 1.21  | 0.042     | 0.048 |
| X   | 1.07        | 1.42  | 0.042     | 0.056 |
| Y   | -           | 0.50  | -         | 0.020 |
| Z   | 2°          | 10°   | 2°        | 10°   |
| G1  | 15.50       | 16.00 | 0.610     | 0.630 |
| K1  | 1.02        | -     | 0.040     | -     |
| Z1  | 2°          | 10°   | 2°        | 10°   |

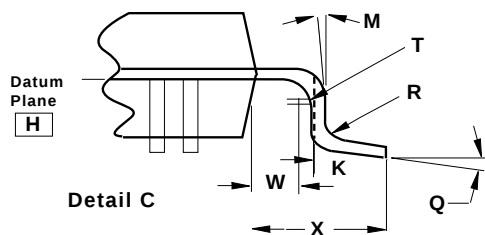


#### Notes

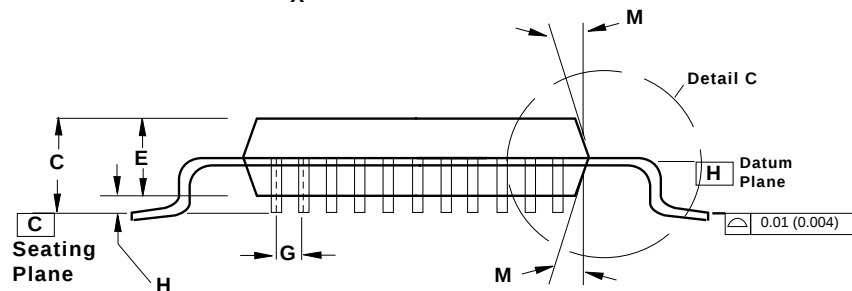
1. Dimensioning and tolerancing per Ansi Y14.5-M, 1982
2. Controlling dimension: Millimeter
3. Datum Plane "H" is located at the bottom of the lead and is coincident with the lead where the lead exits the plastic body at the bottom of the parting line.
4. Datums -A-, -B-, and -D- to be determined at Datum Plane -H-
5. Dimensions S and V to be determined at seating plane -C-
6. Dimensions A and B do not include Mold protusion. Allowable protusion is 0.25 (0.010) per side. Dimensions A and B do include mold mismatch and are determined at Datum Plane -H-.
7. Dimension D does not include Danbar protusion. Allowable Danbar protusion is 0.08 (0.003) total in excess of the D dimension at Maximum Material Condition. Danbar cannot be located on the lower radius or the foot.



Section B-B



Detail C



| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 9.90        | 10.10 | 0.390  | 0.398 |
| B   | 9.90        | 10.10 | 0.390  | 0.398 |
| C   | 2.10        | 2.45  | 0.083  | 0.096 |
| D   | 0.30        | 0.45  | 0.012  | 0.018 |
| E   | 2.00        | 2.10  | 0.079  | 0.083 |
| F   | 0.30        | 0.40  | 0.012  | 0.016 |
| G   | 0.80        | BSC   | 0.031  | BSC   |
| H   | -           | 0.25  | -      | 0.010 |
| J   | 0.13        | 0.23  | 0.005  | 0.009 |
| K   | 0.65        | 0.95  | 0.026  | 0.037 |
| L   | 8.00        | REF   | 0.315  | REF   |
| M   | 5°          | 10°   | 5°     | 10°   |
| N   | 0.13        | 0.17  | 0.005  | 0.007 |
| Q   | 0°          | 7°    | 0°     | 7°    |
| R   | 0.13        | .30   | 0.005  | 0.012 |
| S   | 12.95       | 13.45 | 0.510  | 0.530 |
| T   | 0.13        | -     | 0.005  | -     |
| U   | 0°          | -     | 0°     | -     |
| V   | 12.95       | 13.45 | 0.510  | 0.530 |
| W   | 0.40        | -     | 0.016  | -     |
| X   | 1.6         | REF   | 0.063  | REF   |

## 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      | 25                   | mA   |
| Operating Temperature                               | TA     | T low to T high      | °C   |
| UR5HCFJL-xx                                         |        | -40 to +85           |      |
| Storage Temperature Range                           | Tstg   | -65 to +150          | °C   |
| <b>ESD rating</b> (human body model)                | VESD   | TBD                  | KV   |

### Thermal Characteristics

| Characteristic     | Symbol | Value | Unit     |
|--------------------|--------|-------|----------|
| Thermal Resistance |        |       |          |
| ■ Plastic PLCC     | Tja    | 70    | °C per W |

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

| Characteristic                     | Symbol | Min     | Typ | Max     | Unit |
|------------------------------------|--------|---------|-----|---------|------|
| Output Voltage (I load<10µA)       | Vol    |         |     | 0.1     | V    |
|                                    | Voh    | Vdd-0.1 |     |         |      |
| Output High Voltage (I load=0.8mA) | Voh    | Vdd-0.8 |     |         | V    |
| Output Low Voltage (I load=1.6mA)  | Vol    |         |     | 0.4     | V    |
| Input High Voltage                 | Vih    | 0.7xVdd |     | Vdd     | V    |
| Input Low Voltage                  | Vil    | Vss     |     | 0.2xVdd | V    |
| User Mode Current                  | Ipp    |         | 5   | 3.5     | mA   |
| Data Retention Mode (0 to 70°C)    | Vrm    | 2.0     |     |         | V    |
| Supply Current*                    | Idd    |         |     |         |      |
| ■ Run                              |        |         | 2.5 | 3.5     | mA   |
| ■ Wait                             |        |         | 0.8 | 1.5     | mA   |
| ■ Start                            |        |         | 2.0 | 50      | µA   |
| I/O Ports Hi-Z Leakage Current     | Iil    |         |     | +/-10   | µA   |
| Input Current                      | Iin    |         |     | +/- 1   | µA   |
| I/O Port Capacitance               | Cio    |         | 8   | 12      | pF   |

\*In a typical application circuit, including external A/D.

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

| Characteristic                      | Symbol   | Min  | Max | Unit |
|-------------------------------------|----------|------|-----|------|
| Frequency of operation              |          |      |     |      |
| ■ Crystal option                    | fosc     |      | 2.0 | MHz  |
| ■ External clock option             | fosc     | dc   | 2.0 | MHz  |
| Internal operating frequency        |          |      |     |      |
| ■ Crystal (fosc/2)                  | fop      |      | 1.0 | MHz  |
| ■ External clock option (fosc/2)    | fop      | dc   | 1.0 | MHz  |
| Cycle time                          | tcyc     | 1000 |     | ns   |
| Crystal oscillator startup time     | toxov    |      | 100 | ms   |
| Stop recovery startup time          | tiLCH    |      | 100 | ms   |
| Reset pulse width                   | trL      | 8    |     | tcyc |
| Interrupt pulse width low           | tLIH     | 125  |     | ns   |
| Interrupt pulse period              | tIIL     | *    |     | tcyc |
| Oscillator input (OSCI) pulse width | tOH, TOL | 90   |     | ns   |

\*The minimum period tIIL should not be less than the number of cycle times it takes to execute the interrupt service routine plus 21 tcyc.



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