GreenCoder™ UR5HCFJL
Zero-Power™ Keyboard Encoder for Portable Systems

HID & SYSTEM MANAGEMENT PRODUCTS, KEYCODER™ FAMILY

DESCRIPTION

The GreenCoder™ (UR5HCFJL) is a unique, Zero-Power™ keyboard encoder that provides an optimum performance level for both battery-operated and desktop systems.

The GreenCoder™ scans, debounces and encodes an 8 X 16 keyboard matrix, and will provide direct drive for 3 LEDs and two bi-directional channels for communication with a BIOS-compatible system as well as an additional keyboard-compatible device. It fully supports all three PS/2 scan code sets and will implement up to three alternate keyboard layers for full 101/102 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 user 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.

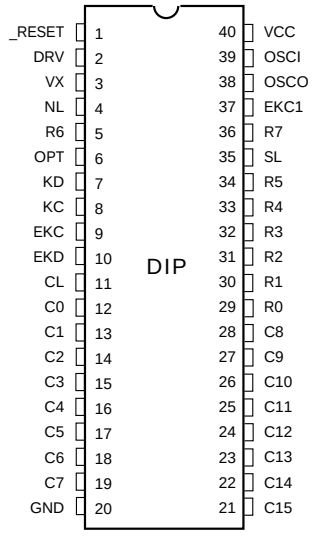
FEATURES

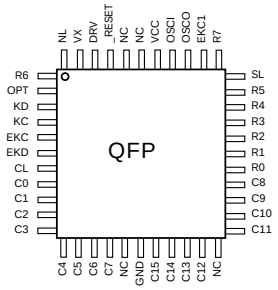
- Optimized power-saving operation with idle consumption of less than 2 µA
- Programmable LED dimming for further power savings
- Ready to interface to Fujitsu's 7316, 7654,7656, and 1406 keyboards
- 3, 3.3 and 5 Volt operation
- Wakes-up only to respond to an external event and for a minimum period of time (2 mA current consumption)
- Provides interface for external keyboard/keypad or other 8042-compatible device
- Custom versions available in small or large quantities

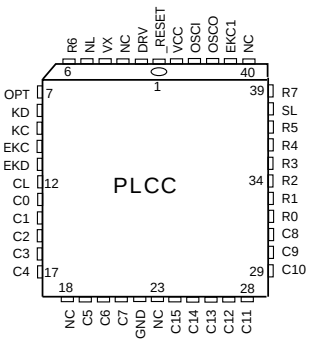
APPLICATIONS

- Laptop/Notebook
- Portable Equipment
- Energy Star Compliant
- Medical Instruments
- Palmtops/ PDAs

PIN ASSIGNMENTS







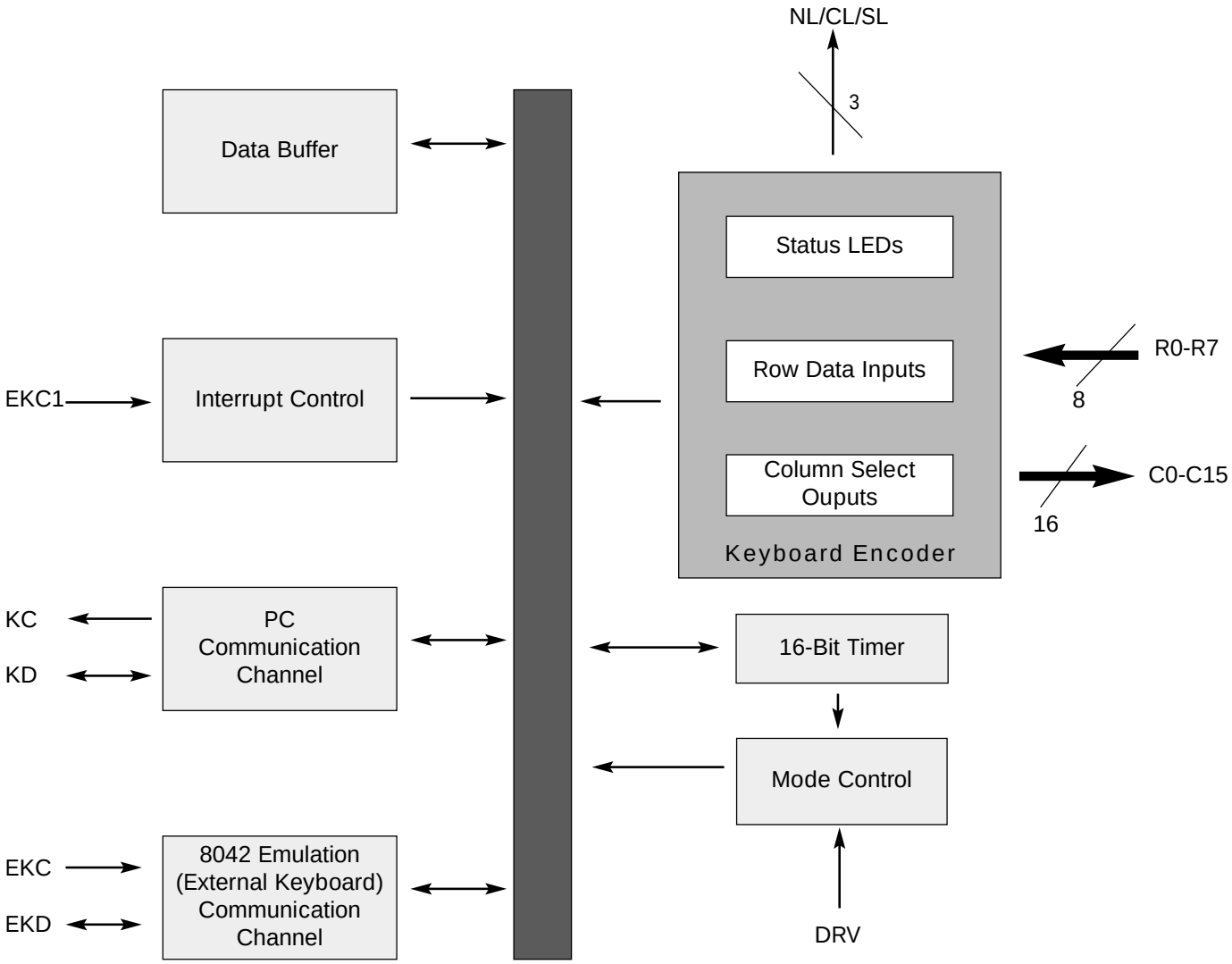
GreenCoder is a trademark of Semtech Corp. All other trademarks belong to their respective companies.

ORDERING CODE

Package options	Pitch In mm's	TA = -40°C to +85°C
40-pin Plastic DIP	2 54 mm	UR5HCFJL-XX-P
44-pin, Plastic PLCC	1.27 mm	UR5HCFJL-XX-FN
44-pin, Plastic QFP	0.8 mm	UR5HCFJL-XX-FB

XX = 16 for FKB7136,06 for FKB1406 matrix compatibility

FUNCTIONAL DIAGRAM



SEMTECH

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 1 of the 16 column lines (C0-C15) every 512 µS and then reads the row 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 UR5HCFJL 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. Custom scan code tables, including macros, are also available.

PIN DEFINITIONS

Mnemonic	DIP	PLCC	QFP	Type	Name and Function
VCC	40	44	38	I	Power Supply: +5V
VSS	20	22	17	I	Ground
OSCI	39	43	37	I	Oscillator input
OSCO	38	42	36	O	Oscillator output
_RESET	1	1	41	I	Reset: apply 0V to provide orderly start-up
EKC1	37	41	35	I	External Keyboard Clock 1:connects to external keyboard clock line and is used to generate an interrupt for every clock line transmission
VX	3	4	43	I	Tie to Vcc
OPT	6	7	2	I	Used for options selection
KC	8	9	4	I/O	Keyboard Clock: connects to PC keyboard port data line
KD	7	8	3	I/O	Keyboard Data: connects to PC port data line
EKD	10	11	6	I/O	External Keyboard Data: connect to external keyboard clock line
EXC	9	10	5	I/O	External Keyboard Clock 1: connects to external keyboard data line
DRV	2	2	42	I	Wake-up line: used for sleep mode
R0-R5	29-34	32-37	27-32	I	Row Data Inputs
R6	5	6	1	I	
R7	36	39	34	I	
C0-C4	12-16	13-17	8-12	I/O	Column Select Outputs: select 1 of 16 columns
C5-C7	17-19	19-21	13-15	O	
C8-C15	28-21	31-24	26-18	O	
CL	11	12	7	O	Caps Lock LED
NL	4	5	44	O	Num Lock LED
SL	35	38	33	O	Scroll Lock LED
NC		3,18 23,40	39-40 16,22		No Connects: these pins are unused

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

KEYBOARD ENCODER, (CON'T)

Embedded Numeric Keypad

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

FN Key

A special FN Key has been implemented to perform the following functions while it is held pressed:

- Function Key F1 becomes F11
- Function Key F2 becomes F12
- Control Left Key becomes Ctrl Right
- Embedded numeric keypad keys become regular keys

If Num Lock is not set:

- Embedded numeric keypad keys provide the same codes as a numeric keypad when the Num Lock is not set (Arrow keys, PgUp, PgDn, etc.)

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.

MODE CONTROL

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) will be 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 effects of accidental key presses.

"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.

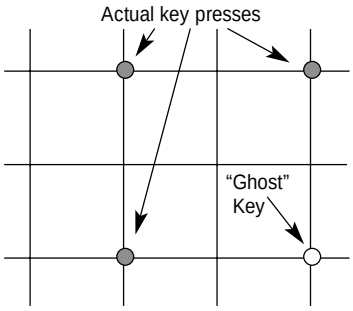


Figure 1: "Ghost" or "Phantom" Key Problem

8042 EMULATION CHANNEL

The GreenCoder™ fully emulates a system's keyboard port, available to a standard 84/85/101/102 external keyboard or other 8042-compatible device. Communication with a keyboard-compatible device is accomplished by clock and data lines via EKC and EKD pins, respectively. A third pin, EKC1 that connects to the Clock Line, interrupts the controller whenever the external device initiates a communication session.

When power is first applied, the controller proceeds with the standard reset sequence with the external device. Data and commands initiated from the external device are buffered in the controller's FIFO along with data from the scanned matrix, and then are presented to the system as if they were coming from a single source. Once they are acknowledged, commands and data from the system are then transmitted to the external device.

SPECIAL HANDLING

Connection of External Device

The UR5HCFJL will detect 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 encoder will proceed with the normal reset routine in order to properly initialize the external device. After communication has been established, the encoder will continue to check for the presence of the external device. While the external device is connected, the encoder will not enter the sleep mode. If the device is disconnected at a later time, the encoder will become aware of it. If a subsequent connection takes place, the controller will re-initiate 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 will be 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 will be affected on both keyboards. The LED status indicators are properly set after each new connection of an external keyboard.

PC COMMUNICATION

The UR5HCFJL 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 UR5HCFJL 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	ED
Echo	EE
Invalid Command	EF
Select Alternate Scan Codes	F0
Invalid Command	F1
Read ID	F2
Set Typematic Rate/Delay	F3
Enable	F4
Default Disable	F5
Set Default	F6
Set All Keys	
■ Typematic	F7
■ Make/Break	F8
■ Make	F9
■ Typematic/Make/Break	FA
Set Key Type	
■ Typematic	FB
■ Make/Break	FC
■ Make	FD
Resend	FE
Reset	FF

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	00*
Keyboard ID	83AB
BAT Completion Code	AA
BAT Failure Code	FC
Echo	EE
Acknowledge (Ack)	FA
Resend	FE
Key Detection Error/Overrun	FF**

*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™.

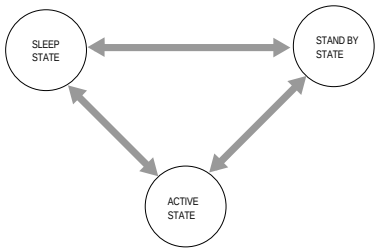


Figure 2: States of Operation of UR5HCFJL

Most of the time, the GreenCoder™ is in the Sleep State. Power consumption in this state is approximately 2 µA 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 IC consumes approximately 600 µA 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 Corp. patent and copyright rights. Purchase of any version of the UR5HCFJL encoder conveys a license to utilize the Self-Power Management feature only through use of the UR5HCFJL in a PS/2-compatible keyboard subsystem.

KEY MAP FOR FKB7211 (UR5HCFJL-11)

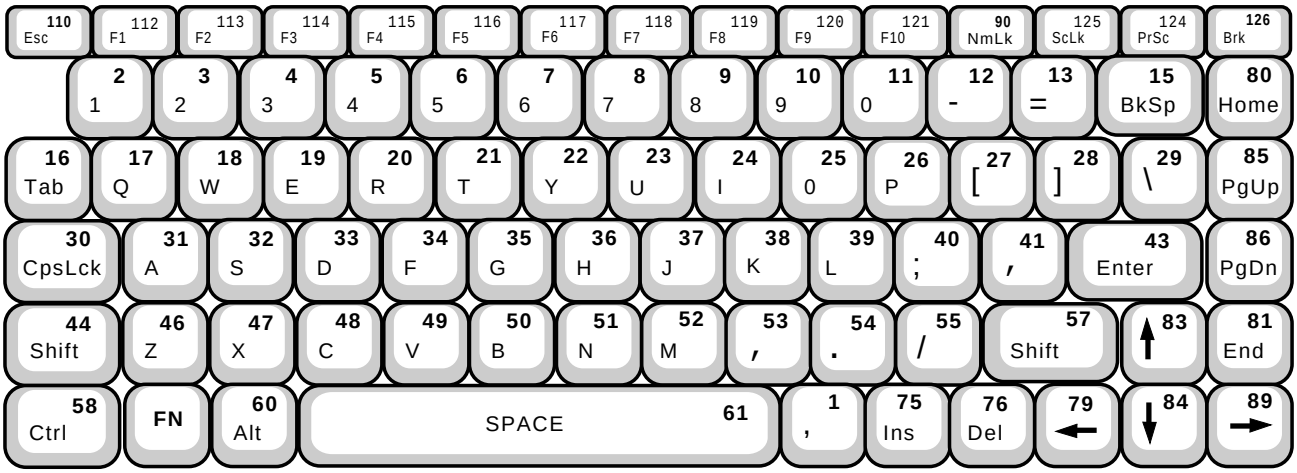
Columns (C0–C13)

Rows (R0–R7)	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) Pad .	/ Pad /		ArrUp	RShift	End
		1	CapLk			V	B	N	M Pad 0	, (com)	, (appos)	Enter		PgDn
		F2	A			S	D	F	J Pad 1	K Pad 2	L Pad 3	; Pad +		PgUp
		2	3			4	T	Y	U Pad 4	I Pad 5	O Pad 6	P Pad -		BkSpc
		F4	F5			F6	F7	F8	F9	F10	NumLk	ScrLk		PrtScr
		F3	% 5			6	7 Pad 7	8 Pad 8	9 Pad 9	0 Pad *	- (dash)	=		Pause
		Q	W			E	R	G	H	[	]	\		Home

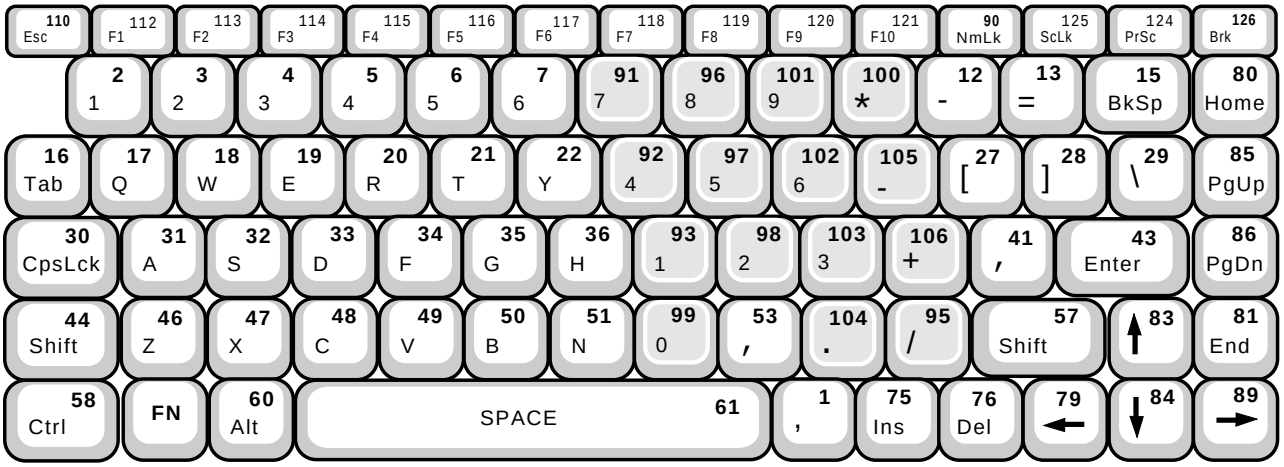
KEYBOARD LAYOUTS (US ENGLISH)

Depending on the status of the Num Lock and the FN Key, the UR5HCFJL implements one of four keyboard layouts.(Key numbering of a standard 101/102 keyboard is shown.)

Layout A (Default layout)



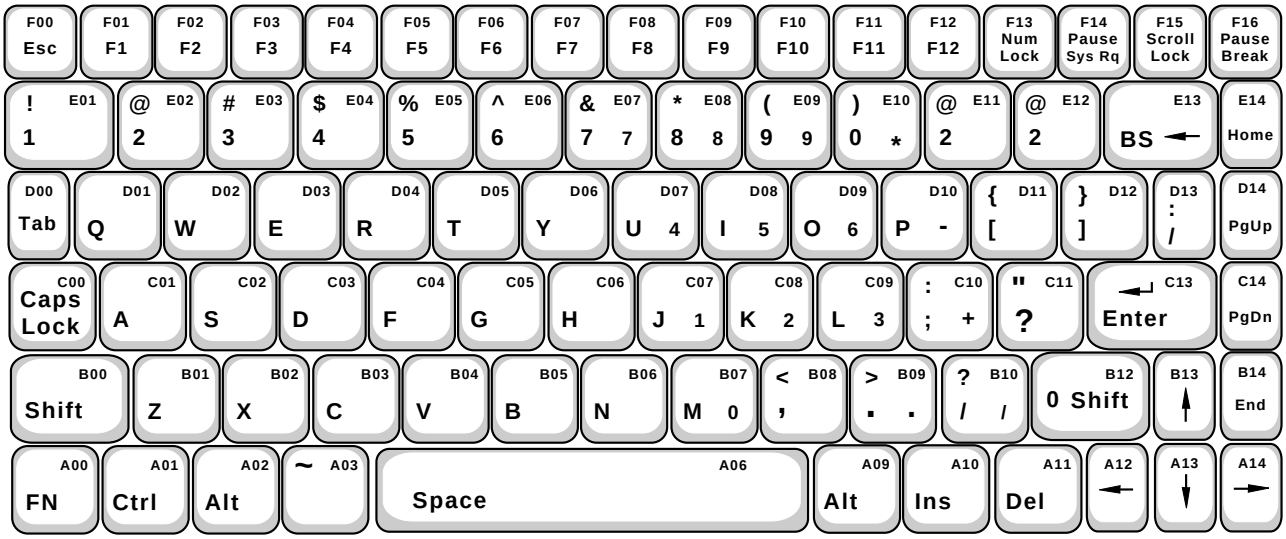
Layout B (Num Lock is set)



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

Rows (R0–R7)	Columns C0-C15															
	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
2		Tab	F3	BkSpc	T	CapLk	RSB		Y	LShift	LBS	F7				
3	PgUp	LQ	F2	F9	K5	F1	=	FN	K6		Dash	F8		Del	Ins	Home
4	LCtrl	A	D	\	F	S	K		J		SCol	L				
5		Z	C	Enter	V	X	Comma		M	RShift		Period		NumLk		Pause
6	PgDn	K1	K3	F10	K4	K2	K8		K7		K0	PK	PrtScr	F11	F12	End
7		Q	E		R	W	I		U		P	O	ScrLk			

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



KEY MAP FOR FUJITSU FKB1406 (UR5HFJL-06)

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

* In FN Case:
LCtrl = RCtrl
LAlt = RAlt

Refer to Page 4 for a description of FN key specifics.

KEY LAYOUT FOR FUJITSU FKB1406 (UR5HFJL-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	0/*N**	O/*N6*	./*N.*			L/*N3*	NumLk/ *FScrlLk*
10	Pause	=	]	\			[	`
11	BkSp	DnArr/ *FPgDn*	UpArr/ *FPgUp*	‘	WinApp	Enter		Ins/ *FPrtScr*
12				RWin				
13	RArr/ *FEnd*	LArr/ *FHome*	Del/ *FSysReq*	/ / *N/*		;/*N+*	P/*N-*	-
14		LCtrl					RCtrl	
15	LShft		RShft					

Note1: The letter N in italics, followed by a number or symbol, indicates that key in Num Case.
Note2: The letter F in italics, followed by a key function, indicates that key in Function Case.

SEMTECH

KEYBOARD LAYOUT FOR THE FUJITSU FKB7654

IMPLEMENTATION NOTES FOR THE UR5HCFJL

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

The Built-in Oscillator on the UR5HCFJL requires the attachment of the 4.00 MHz Ceramic Resonators with built-in Load Capacitors.. You can use either an AVX, part number PBRC-1.00 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.

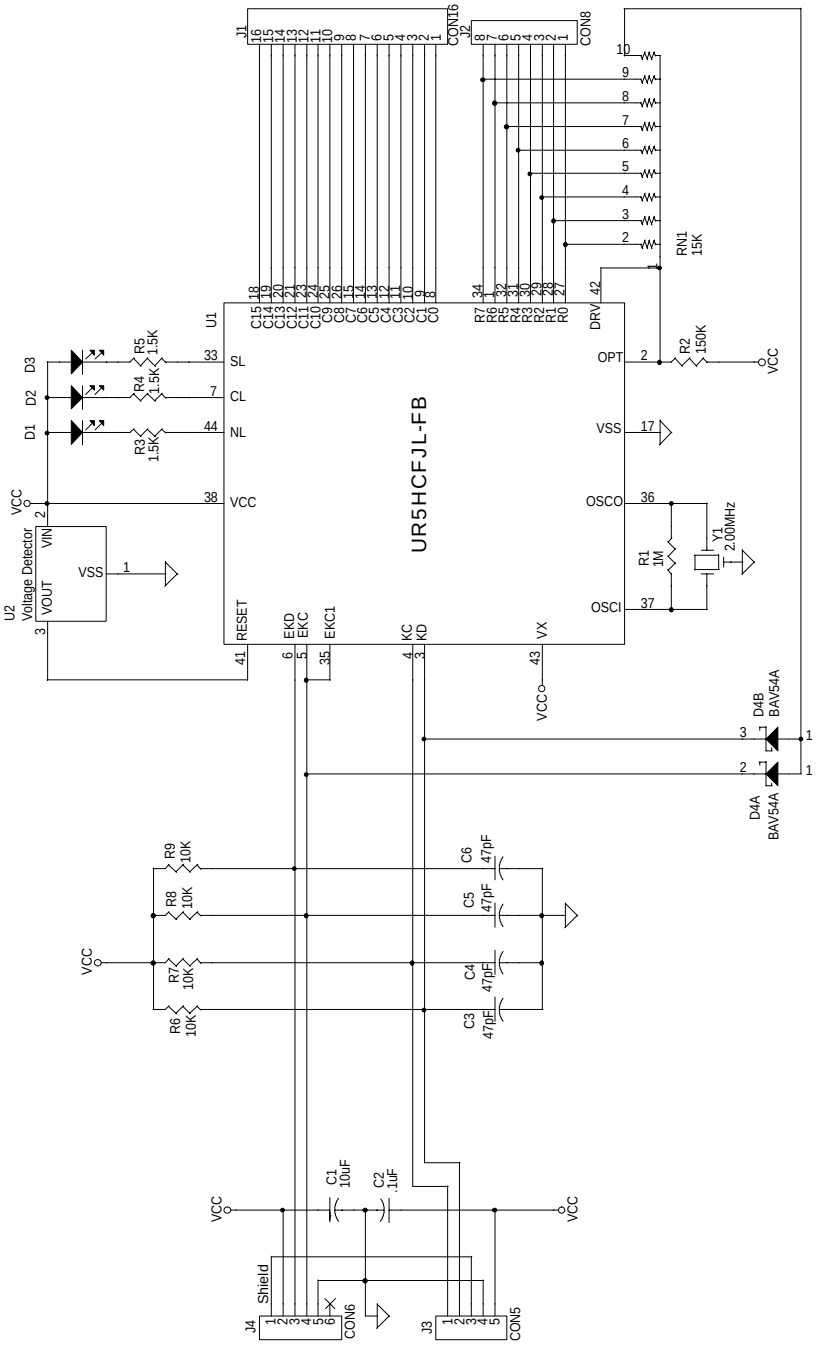
Also, if Crystal is attached, two Load Capacitors (33pF to 47pF) should be added, a Capacitor between each side of the Crystal and ground.

In both cases, using Ceramic Resonator with built-in Load Capacitors, or Crystal with external Load Capacitors, a feedback Resistor of 1 Meg should be connected between OSCin and OSCout.

Troubleshoot the circuit by looking at the Output pin of the Oscillator. If the voltage it half-way between Supply and Ground (while the Oscillator should be running) --- the problem is with the Load Caps / Crystal. If the voltage it all the way at Supply or Ground (while the Oscillator should be running) --- there are shorts on the PCB.

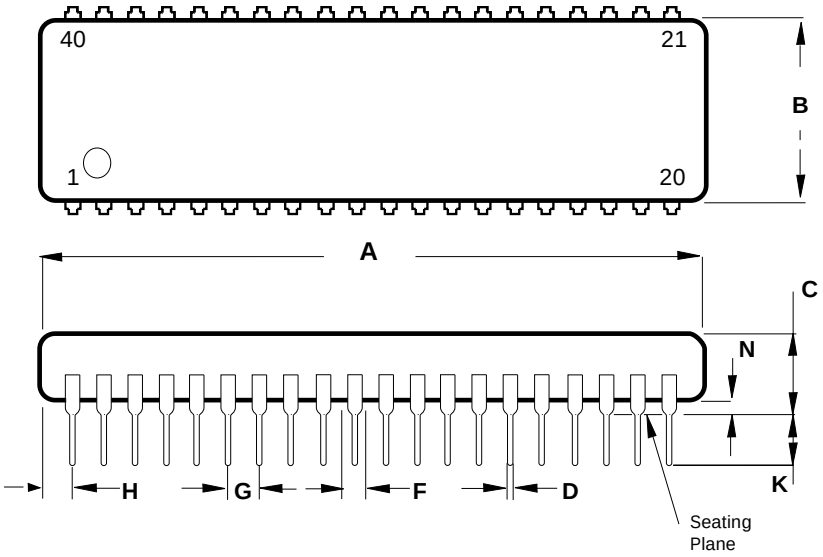
NOTE: when the Oscillator is intentionally turned OFF, the voltage on the Output pin of the Oscillator is High (at the Supply rail).

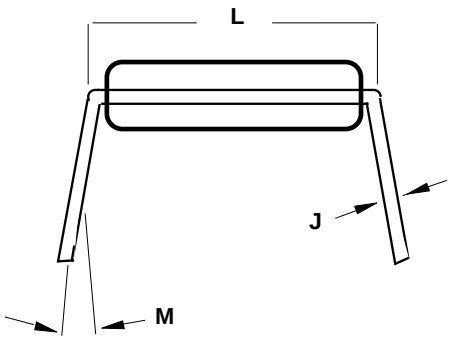
SUGGESTED INTERFACING FOR THE GREENCODER™ UR5HCFJL-FB



SEMTECH

MECHANICALS FOR THE UR5HCFJL-P



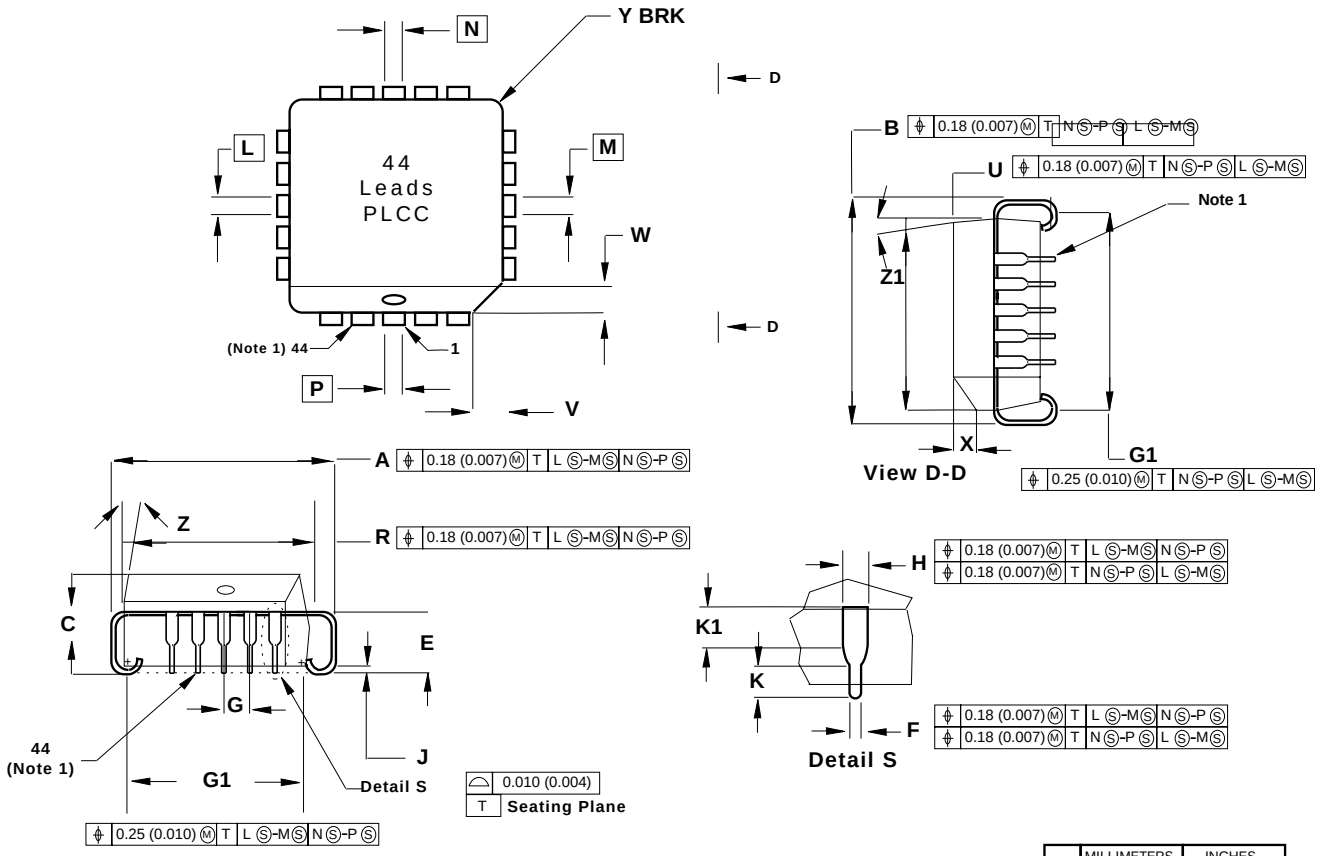


Notes:

1. Positional tolerance of leads (D) shall be within 0.25 mm (0.010) at maximum material condition, in relation to the seating plane and each other.
2. Diminsion L is to the center of the leads when the leads are formed parallel.
3. Dimension B does not include mold flash.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	51.69	52.45	2.035	2.065
B	13.72	14.22	0.540	0.560
C	3.94	5.08	0.155	0.200
D	0.36	0.56	0.014	0.022
F	1.02	1.52	0.040	0.060
G	2.54 BSC		0.100 BSC	
H	1.65	2.16	0.065	0.085
J	0.20	0.38	0.008	0.015
K	2.92	3.43	0.015	0.135
L	15.24 BSC		0.600 BSC	
M	0^{0}	15^{0}	0^{0}	15^{0}
N	0.51	1.02	0.020	0.040

MECHANICALS FOR THE UR5HCFJL-FN



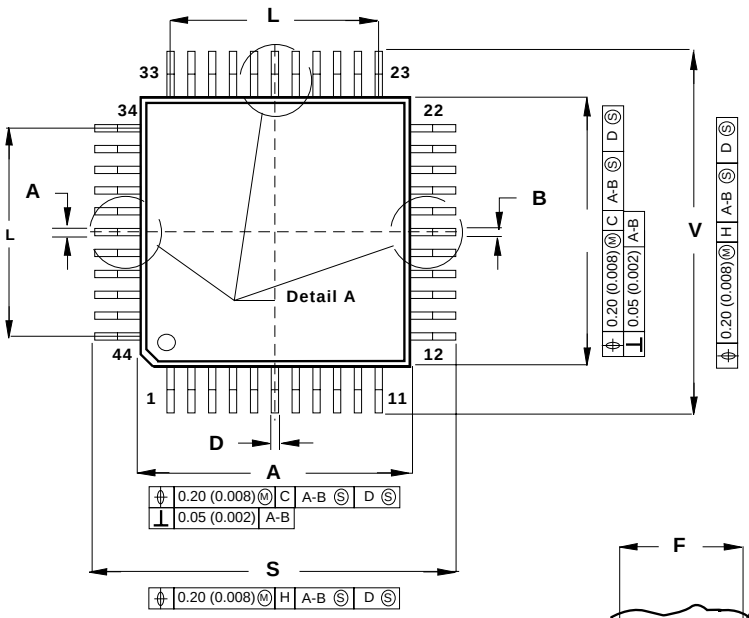
Notes:

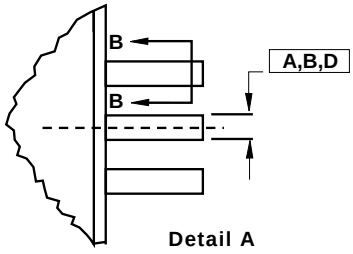
1. Due to space limitation, the chip is represented by a general (smaller) case outline drawing rather than showing all 44 leads.
2. Datums L, M, N, and P determine where the top of the lead shoulder exits plastic body at mold parting line
3. DIM G1, true position to be measured at Datum T, Seating Plane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

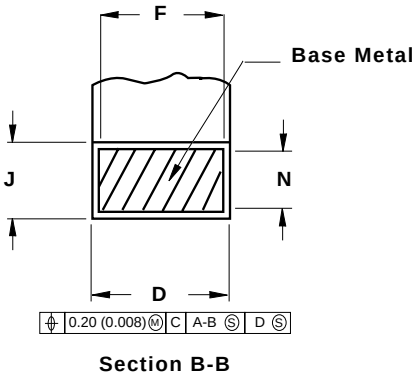
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	17.40	17.65	0.685	0.695
B	17.40	17.65	0.685	0.695
C	4.20	4.57	0.165	0.180
E	2.29	2.79	0.090	0.110
F	0.33	0.48	0.013	0.019
G	1.27 BSC		0.050 BSC	
H	0.66	0.81	0.026	0.032
J	0.51	-	0.020	-
K	0.64	-	0.025	-
R	16.51	16.66	0.650	0.656
U	16.51	16.66	0.650	0.656
V	1.07	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°

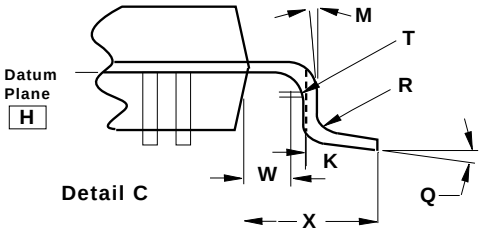
SEMTECH

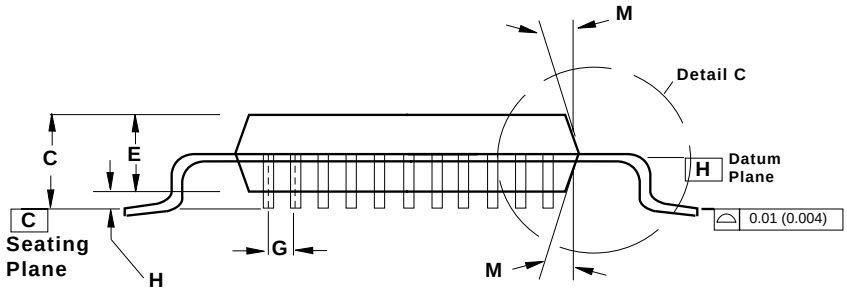
MECHANICALS FOR THE UR5HCFJL-FB











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 protrusion. Allowable Danbar protrusion 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.

	MILLIMETERS		INCHES	
DIM	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	

SEMTECH

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 (not including Vss or Vdd)	I	25	mA
Operating Temperature UR5HCFJL-XX	TA	T low to T high -40 to +85	°C
Storage Temperature Range	Tstg	-65 to +150	°C

Thermal Characteristics

Characteristic	Symbol	Value	Unit
Thermal Resistance	Tja		°C per W
■ Plastic DIP		60	
■ Plastic PLCC		70	

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	fosc			MHz
■ Crystal Option			2.0	
■ External Clock Option		dc	2.0	
Crystal Oscillator Startup Time	fop			MHz
■Crystal (fosc/2)			2.0	
■External Clock Option		dc	2.0	
Cycle Time	tcyc	1000		ns
Crystal Oscillator Startup Time	toxov		100	ms
Stop Recovery Startup Time	t_{ILCH}		100	ms
Reset Pulse Width	t_{RL}	8		tcyc
Interrupt Pulse Width Low	t_{LIH}	125		ns
Interrupt Pulse Period	t_{ILIL}	*		tcyc
OSC1Pulse Width	t_{OH}, t_{OL}	90		ns

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

SEMTECH

For sales information and product literature, contact:

HID & System Mgmt Division
Semtech Corporation
568 Broadway
New York, NY 10012
hidinfo@semtech.com
http://www.semtech.com
212 226 2042 Telephone
212 226 3215 Telefax

Semtech Western Regional Sales
805-498-2111 Telephone
805-498-3804 Telefax

Semtech Central Regional Sales
972-437-0380 Telephone
972-437-0381 Telefax

Semtech Eastern Regional Sales
203-964-1766 Telephone
203-964-1755 Telefax

Semtech Asia-Pacific Sales Office
+886-2-2748-3380 Telephone
+886-2-2748-3390 Telefax

Semtech Japan Sales Office
+81-45-948-5925 Telephone
+81-45-948-5930 Telefax

Semtech Korea Sales Sales
+82-2-527-4377 Telephone
+82-2-527-4376 Telefax

Northern European Sales Office
+44 (0)2380-769008 Telephone
+44 (0)2380-768612 Telefax

Southern European Sales Office
+33 (0)1 69-28-22-00 Telephone
+33 (0)1 69-28-12-98 Telefax

Central European Sales Office
+49 (0)8161 140 123 Telephone
+49 (0)8161 140 124 Telefax