"Zero Power" Keyboard Encoder for Laptop Computers PlexiCoder™ UR5HCPLX-LT

Preliminary

Description

The UR5HCPLX-LT, a member of the PlexiCoder™ series of quasi-zero power keyboard encoders, provides the flexibility and functionality necessary for Laptop computing

In one small footprint package, the UR5HCPLX-LT offers full keyboard control, including support for Windows Keys, an external PS/2 peripheral connection port, and a range of system power management functions.

The UR5HCPLX-LT will scan, debounce and encode an 8 X16 multi-layer keyboard matrix, and will provide direct drive for three status LEDs and two bidirectional channels for communication with both an 8042 compatible controller and an additional keyboard-compatible device. The UR5HCPLX-LT is ready-to-connect to a variety of existing keyboards, including Fujitsu's FKB7316, the smallest touch-typing keyboard.

The UR5HCPLX-LT employs a proprietary Self-Power Management™ method that reduces the power consumption of the keyboard sub-system to an unprecedented minimum, transparently and with no system intervention. Active, the IC consumes less than 2 mA. Inactive, it consumes less than 2 uA (Typ @5V). Suitable for use as the sole powered IC for user-invoked system wake-ups, designers have the option to power-down every peripheral, including those connected to the IC through the signal line, during suspend. The UR5HCPLX-LT will detect the power-down condition and actively control leakage currents to the powered-down peripherals. The IC can then wake the system upon any keystroke.

The enhanced functionality and low power consumption of the UR5HCPLX-LT makes it ideal for use in Laptop computers.

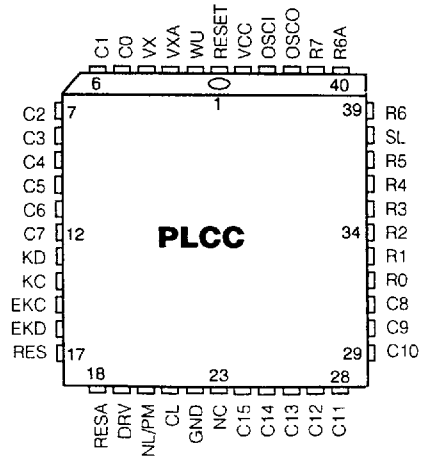
Features

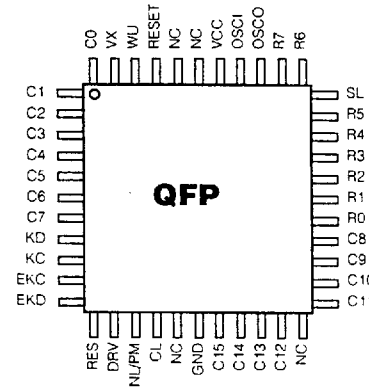
- *Optimized power saving operation with idle consumption of less than 2 uA*
- *System power management features*
- *"Any-Key Wake-up" (AKW) feature*
- *Provides hot-pluggable auxiliary port for external PS/2 compatible devices*
- *Interface to 8 X 16 multi-layer keyboards*
- *System Interface to any PC Open Architecture Standard 8042 compatible keyboard port*
- *Supports "Windows Keys"*
- *"Active Leakage Control" to powered-down interconnects*
- *Connects up to three LEDs*
- *3, 3.3 and 5 Volt operation*
- *Custom versions available in small or large quantities*

Applications

- *Laptop*
- *Portable equipment*
- *Sub-notebooks*
- *Palmtops*

Pin Descriptions



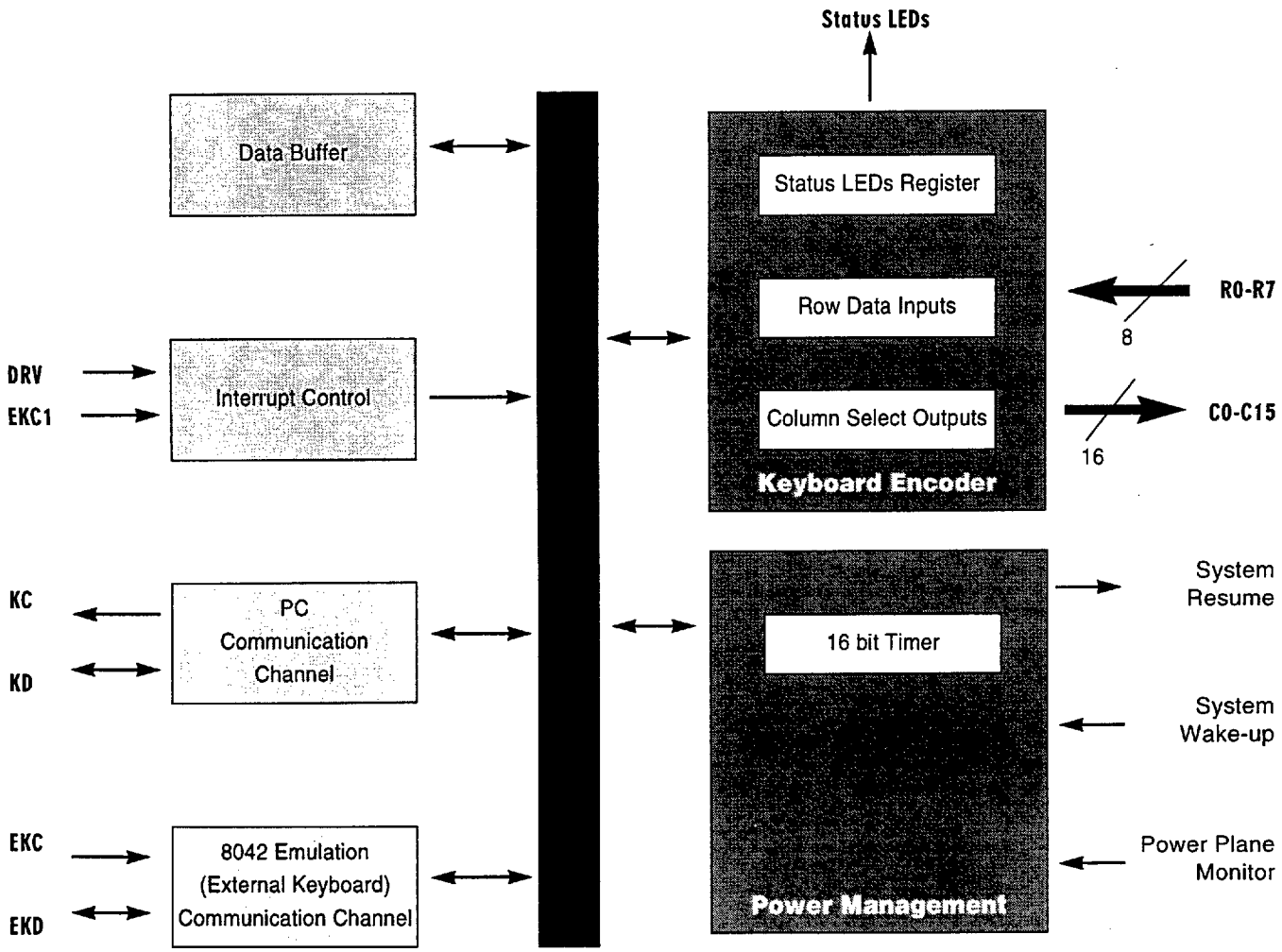


Ordering Code

PACKAGES	TA = 0°C TO +70°C	TA = -40°C TO +85°C
40 pin, Plastic DIP	UR5HCPLX-P-XX	UR5HCPLX-CP-XX
44 pin, Plastic PLCC	UR5HCPLX-FN-XX	UR5HCPLX-CFN-XX
44 pin, Plastic QFP	UR5HCPLX-FB-XX	UR5HCPLX-CFB-XX

XX = 06 For Fujitsu FKB1406

Functional Diagram



Functional Description

The UR5HCPLX-LT consists functionally of five major sections (see Functional Diagram, previous page). These are the Keyboard Encoder, the Peripheral Control Unit, the Power Management unit, 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 us 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 UR5HCPLX-LT supports all three scan code table sets. Scan Code Sets 1 and 2 are the default sets for PC/XT and AT/PS2 systems respectively. 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 Description

	Pin Numbers				
Mnemonic	DIP	PLCC	QFP	TYPE	NAME AND FUNCTION
VCC	40	44	38	I	**Power Supply:** 3-5V.
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 0 V to provide orderly start up.
VX,VXA	3	3,4	43		Tie to VCC (On PLCC tie VX to VXA)
KC	13	14	9	I/O	**Keyboard Clock:** this pin connects to PC keyboard port clock line.
KD	12	13	8	I/O	**Keyboard Data:** connects to PC keyboard port data line.
EKD	15	16	11	I/O	**External Keyboard Data:** connects to external keyboard data line.
EKC	14	15	10	I/O	**External Keyboard Clock:** connects to external keyboard clock line.
DRV	17	19	13	I	**DRV:** used in sleep mode
R0-R5	29-34	32-37	27-32	I	**Row Data Inputs**
R6,R7	36,35	39,41	34,35	I	
R6A		40			PLCC Package Only-Tie to R6
C0-C7	4-11	5-12	44 1-7	O	**Column Select Outputs:** select 1 of 16 columns.
C8-C15	28-21	31-24	26-18		
RES	16	17	12	O	**Resume:** System Resume Output, provides CPU Wake Up Interrupt
RESA		18			PLCC Package Only-Tie to R6
WU	2	2	42	I	**Wake up:** System Wake up event input
NL/PM	18	20	14	O/I	**NumLk LED/Power Monitor:** Num Lock LED output and Power Monitor input
CL	19	21	15	O	**Caps Lock LED**
SL	35	38	33	O	**Scroll Lock LED**

Keyboard Scanning

Embedded Numeric Keypad

The UR5HCPLX-LT 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
- Alt Left Key becomes Alt Right

If Num Lock is set:

- 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.)

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 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 5ms, 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.

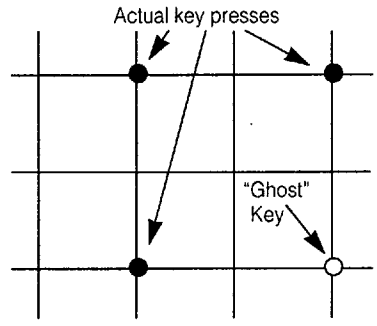


Figure 1: **"Ghost" or "Phantom" Key Problem**

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 UR5HCPLX-LT has built-in mechanisms to detect the presence of a "ghost" key, thus eliminating the necessity of external hardware.

PC Keyboard Communication

The UR5HCPLX-LT implements all the standard functions of communication with a BIOS-compatible AT/PS2 host system. Two lines, KC and KD, provide bidirectional clock and data signals according to the protocol. In addition, the UR5HCPLX-LT 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/PS2 protocol)**

These commands are supported in the AT/PS2 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/PS2 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 affect the normal operation of the UR5HCPLX-LT.

Aux (8042) Port

The UR5HCPLX-LT fully emulates a system's keyboard port, available to a standard 83/101/102 external keyboard or other PS/2 device. Communication with the external 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. After they are acknowledged, commands and data from the system are then transmitted to the external device.

Special Handling

Hot-plug-ins of External Device

The UR5HCPLX-LT 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 keyboard. After communication has been established, the encoder will continue to check for the presence of the external keyboard. 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 be 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

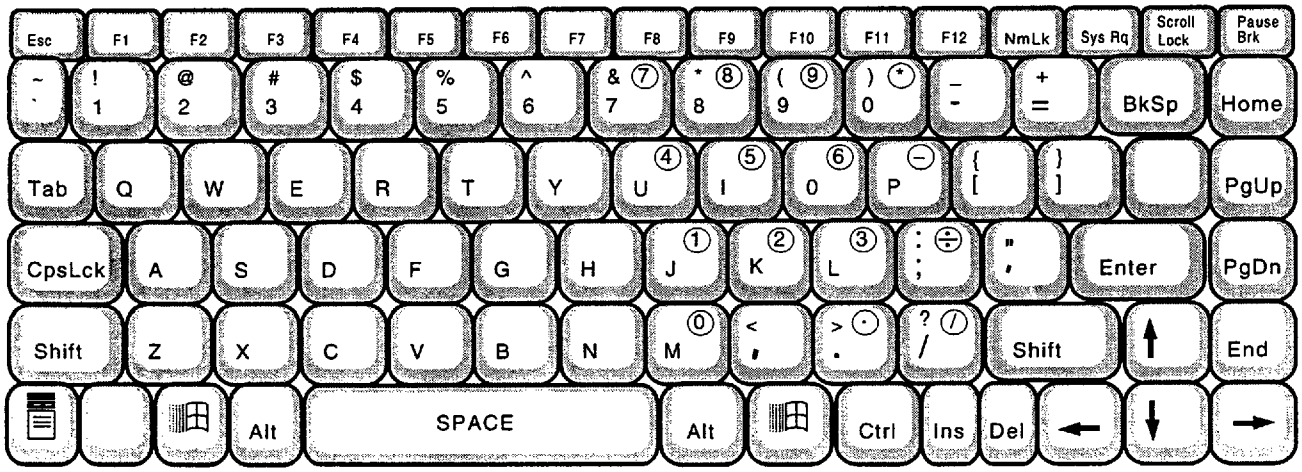
The controller provides an interface for three LED shift status indicators. All three pins are active low to indicate the status of the host system (Num Lock, Caps Lock and Scroll Lock). They are set by either the controller (PC/XT protocol) or by the system (AT/PS2 protocol). After a 2 minutes period of keyboard inactivity, LEDs are dimmed to conserve power. They are set to full brightness again upon a new keystroke

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.

Sample Key Map for the UR5HCPLX-LT

Rows (R0–R7) \ Columns (C0–C15)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0		Win C	Q	W	E	T	Win B				~ `	ArLt	ArDn	End	| \	PgUp
1		! 1				Y		Lft Shft			U	I	O	P	{ [	
2	Lft Ctrl	Esc	@ 2	R	# 3	^ 6						& 7	* 8	) 0	_ -	BkSp
3		F2	F4	F6	$ 4	% 5			Win A			F8	F11	(9	+ =	Pause
4		F1	F3	F5	F12	F7		Rt Shft			Nm Lk	F9	F10	Prt Scn	ScLk	Ins
5		Lft Shft	A		Space	N				Lft Alt	J	K	L	Enter	" '	Del
6	Rt Ctrl	Z	S	D	F	G					H	M	< ,	: ;	}]	Home
7		Caps	X	C	V	B	I			Rt Alt	Tab	ArUp	> .	Ar Rt	? /	PgDn

Sample Keyboard Layout



Special Keyboard Modes

Function Key

The function key is used to invoke the alternate keyboard layouts implemented in the UR5HCPLX-LT. Alternate layouts can be sustained by pressing the Num Lock key. In this case the UR5HCPLX-LT will set the Pad Lock LED output to indicate that the embedded numeric keypad is in effect.

Program Key

The Program Key is used to invoke special system functions.
Key combinations involving the Program Key, do not send codes to the system, but rather invoke peripheral management procedures. Description of the specific functions is presented in the relevant sections of this specification.

Windows 95 Keys

The UR5HCPLX-LT supports the three new Windows 95 keys. These keys are: Application Key, Right Windows Key, and Left Windows Key. Unmodified, the Application Key brings up the"pop-up" menu at the current select position. The Application Key, used in conjunction with the Shift Keys (Ctrl, Alt, Shift), can be used for application-specific functions. Both the Left and Right Window Keys will set the focus to the Windows 95 interface. They may also be used as modifier keys.

States of Operation

The UR5HCPLX-LT 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 UR5HCPLX-LT.

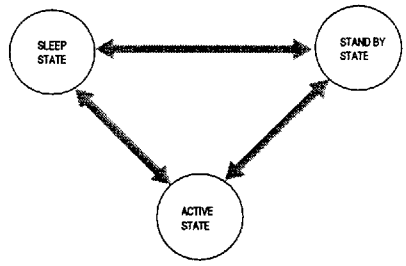


Figure 1: **States of operation of the UR5HCPLX**

Most of the time the UR5HCPLX-LT is in the Sleep State. Power consumption in this state is approximately 2 uA at 5 Volt operation. The UR5HCPLX-LT exits the Sleep State and 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. It remains in this state for only as long as is necessary to process the specific event. The UR5HCPLX-LT 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 UR5HCPLX-LT consumes approximately 600 uA at 5 Volts. Transition from one state to the other does not require any input from the system and is totally transparent to the user.

Note

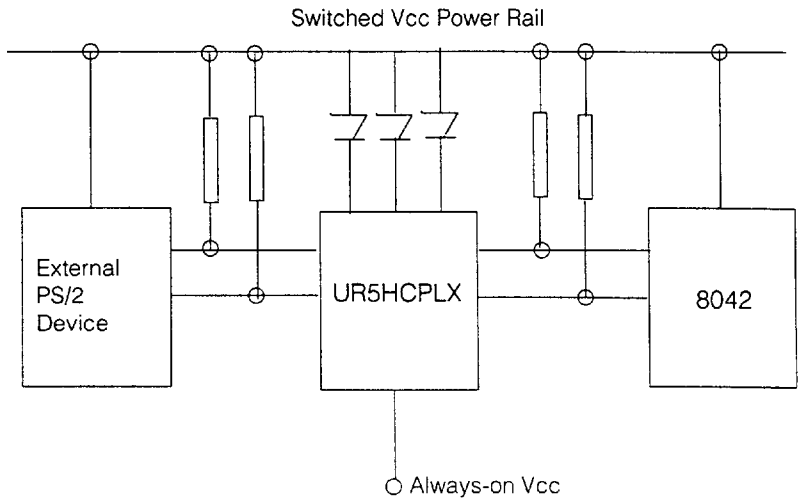
"Self-Power Management" ™ is a feature protected under USAR Systems' patent and copyright rights. Purchase of any version of the UR5HCPLX-LT encoder conveys a license to utilize the Self Power Management feature only through use of the UR5HCPLX-LT in a PS2-compatible keyboard subsystem.

Using the UR5HCPLX-LT for System Management Tasks

The UR5HCPLX-LT can be used as the sole power management IC to control the user invoked "resume" transition on any system based on PC-compatible chip sets. The low power consumption and the "Self Power Management" characteristics of the encoder makes it suitable to be used as the only peripheral IC that remains powered-on while the system enters into the "suspend" mode. Because the UR5HCPLX-LT controls the user interface (keypad/keyboard), it is naturally positioned in the system to provide "resume" SMI (System Management Interrupt) on any user keystroke. Systems employing the UR5HCPLX-LT can turn off the power to any other peripheral including the 8042 keyboard controller. System "resume" can be accomplished either by pressing a dedicated key on the keyboard or by pressing any key designated by the designer. Implementation of "Any Key Resume" will result in loss of the first keystroke.

Power Planes Control

In a typical system the UR5HCPLX-LT will control built-in peripherals such as the keyboard matrix, digital potentiometers for LCD contrast and brightness, LEDs and an optional external PS/2-compatible device. The UR5HCPLX-LT can be powered by its own power line without contributing any significant load to the system battery. Any other interconnected peripheral, including the 8042 keyboard controller, the LEDs and the external keyboard, can be powered by a switched power plane that can be switched off whenever the system enters the "suspend" mode. Switching off devices that are interconnected with powered devices through signal lines will cause leakage currents unless certain precautions are taken. Leakage currents will increase power consumption and defeat the purpose of power management. The UR5HCPLX-LT provides built in features that make it capable of properly handling situations of interconnections with powered-down devices. The following diagram illustrates a typical implementation using the UR5HCPLX-LT interconnected with switched rail powered devices:



Devices Switched Off

In order to control leakage currents when interconnecting powered devices with unpowered ones, designers should make sure that the switched-off power plane voltage drops all the way to ground (within 50 mV). Floating unpowered lines may indicate uncontrolled current paths and will prevent any system from achieving optimized power consumption.

Using the UR5HCPLX for System Management Tasks

UR5HCPLX-LT Switched Power Plane Monitor

The UR5HCPLX-LT is primarily connected to two switched active devices: the external keyboard and the 8042 keyboard controller. Signal lines connected to these devices are normally open collector. The UR5HCPLX-LT will monitor the voltage of the switched power plane. When the power plane is switched off then all participating open collector outputs are driven low preventing leakage currents and noise induced signals through the floating inputs. Pull-up resistors of the open collector outputs should also be turned off.

External Keyboard and 8042 Communications

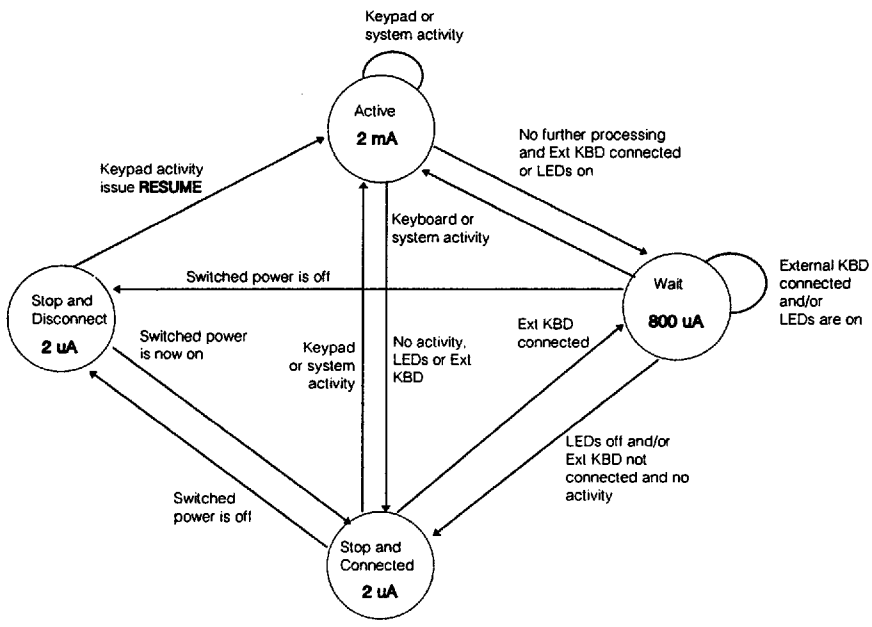
When the system turns off the switched power rail, the encoder will drive low both clock and data lines preventing any further communication with the external device and the 8042-type keyboard controller. If the system re-establishes power both to the 8042 and the external device, the UR5HCPLX-LT should be notified through a wake-up pulse provided by the system. If the 8042 is not powered off, the wake up information can be provided through a command from the system.

System Resume Call

The UR5HCPLX-LT provides an output that will signal the system to resume if a user presses a key when the system is in the suspend mode and power has been switched off to the switched power rail. Note that system may resume upon other signals originating from other system functions.

"Self Power Management" States of the UR5HCPLX-LT

The following diagram shows the power management states of the UR5HCPLX-LT, along with the power consumption associated with each state.



Scan Codes

The following tables list the scan codes associated with each key for each scan code set. To determine the character that corresponds to each key number, refer to the Keyboard Layouts A–D on the previous pages. Scan Code Set 2 is the default when the UR5HCPLX-LT is set in AT/PS2 mode.

Scan Code Set 1 (Part 1 of 5)

The following keys send the assigned scan codes independently of the state of any Shift Keys (Ctrl, Alt and Shift) or the Num Lock State (On or Off).

Key#	Make Code	Break Code	Key#	Make Code	Break Code	Key#	Make Code	Break Code
1	29	A9	**31**	1E	9E	**90**	45	C5
2	02	82	**32**	1F	9F	**91**	47	C7
3	03	83	**33**	20	A0	**92**	4B	CB
4	04	84	**34**	21	A1	**93**	4F	CF
5	05	85	**35**	22	A2	**96**	48	C8
6	06	86	**36**	23	A3	**97**	4C	CC
7	07	87	**37**	24	A4	**98**	50	D0
8	08	88	**38**	25	A5	**99**	52	D2
9	09	89	**39**	26	A6	**100**	37	B7
10	0A	8A	**40**	27	A7	**101**	49	C9
11	0B	8B	**41**	28	A8	**102**	4D	CD
12	0C	8C	**43**	1C	9C	**103**	51	D1
13	0D	8D	**44**	2A	AA	**104**	53	D3
15	0E	8E	**46**	2C	AC	**105**	4A	CA
16	0F	8F	**47**	2D	AD	**106**	4E	CE
17	10	90	**48**	2E	AE	**110**	01	81
18	11	91	**49**	2F	AF	**112**	3B	BB
19	12	92	**50**	30	B0	**113**	3C	BC
20	13	93	**51**	31	B1	**114**	3D	BD
21	14	94	**52**	32	B2	**115**	3E	BE
22	15	95	**53**	33	B3	**116**	3F	BF
23	16	96	**54**	34	B4	**117**	40	C0
24	17	97	**55**	35	B5	**118**	41	C1
25	18	98	**57**	36	B6	**119**	42	C2
26	19	99	**58**	1D	9D	**120**	43	C3
27	1A	9A	**60**	38	B8	**121**	44	C4
28	1B	9B	**61**	39	B9	**122**	57	D7
29	2B	AB	**62**	E0 38	E0 B8	**123**	58	D8
30	3A	BA	**64**	E0 1D	E0 9D	**125**	46	C6

Scan Code Set 1 (Part 2 of 5)

The following keys send a series of codes dependent on the state of the Shift Keys and the state of the Num Lock.

Key	Base Case, or Shift+Num Lk		Shift Case*		Num Lock on	
Number	Make	Break	Make	Break	Make	Break
75	E0 52	E0 D2	E0 AA E0 52	E0 D2 E0 2A	E0 2A E0 52	E0 D2 E0 AA
76	E0 53	E0 D3	E0 AA E0 53	E0 D3 E0 2A	E0 2A E0 53	E0 D3 E0 AA
79	E0 4B	E0 CB	E0 AA E0 4B	E0 CB E0 2A	E0 2A E0 4B	E0 CB E0 AA
80	E0 47	E0 C7	E0 AA E0 47	E0 C7 E0 2A	E0 2A E0 47	E0 C7 E0 AA
81	E0 4F	E0 CF	E0 AA E0 4F	E0 CF E0 2A	E0 2A E0 4F	E0 CF E0 AA
83	E0 48	E0 C8	E0 AA E0 48	E0 C8 E0 2A	E0 2A E0 48	E0 C8 E0 AA
84	E0 50	E0 D0	E0 AA E0 50	E0 D0 E0 2A	E0 2A E0 50	E0 D0 E0 AA
85	E0 49	E0 C9	E0 AA E0 49	E0 C9 E0 2A	E0 2A E0 49	E0 C9 E0 AA
86	E0 51	E0 D1	E0 AA E0 51	E0 D1 E0 2A	E0 2A E0 51	E0 D1 E0 AA
89	E0 4D	E0 CD	E0 AA E0 4D	E0 CD E0 2A	E0 2A E0 4D	E0 CD E0 AA

* If the left Shift Key is held down, the AA/2A, shift make and break is sent with the other scan codes. If the right Shift Key is held down, B6/36 is sent. If both Shift Keys are down, both sets of codes are sent with the other scan codes.

Scan Code Set 1 (Part 3 of 5)

Key	Scan Code		Shift Case	
Number	Make	Brake	Make	Brake
95	E0 35	E0 B5	E0 AA E0 35	E0 B5 E0 2A

*If the left Shift Key is held down, the AA/2A shift make and break is sent with the other scan codes. If the right Shift Key is held down, B6/36 is sent. If both Shift Keys are down, both sets of codes are sent with the other scan codes

Scan Code Set 1 (Part 4 of 5)

Key	Scan Code		Ctrl Case, Shift Case		Alt Case	
Number	Make	Brake	Make	Brake	Make	Brake
124	E0 2AE0 37	E0 B7 E0 AA	E0 37	E0 B7	54	D4

Scan Code Set 1 (Part 5 of 5)

Key Number	Make Code	Ctrl Key Pressed
126*	E1 1D 45 E1 9D C5	E0 46 E0 C6

*This key is not Typematic. All associated scan codes occur on the make of the key.

Scan Code Set 2 (Part 1 of 5)

The following keys send the codes shown regardless of any Shift States in the keyboard or the system.

Key#	Make Code	Break Code
1	0E	F0 0E
2	16	F0 16
3	1E	F0 1E
4	26	F0 26
5	25	F0 25
6	2E	F0 2E
7	36	F0 36
8	3D	F0 3D
9	3E	F0 3E
10	46	F0 46
11	45	F0 45
12	4E	F0 4E
13	55	F0 55
15	66	F0 66
16	0D	F0 0D
17	15	F0 15
18	1D	F0 1D
19	24	F0 24
20	2D	F0 2D
21	2C	F0 2C
22	35	F0 35
23	3C	F0 3C
24	43	F0 43
25	44	F0 44
26	4D	F0 4D
27	54	F0 54
28	5B	F0 5B
29	5D	F0 5D
30	58	F0 58

Key#	Make Code	Break Code
31	1C	F0 1C
32	1B	F0 1B
33	23	F0 23
34	2B	F0 2B
35	34	F0 34
36	33	F0 33
37	3B	F0 3B
38	42	F0 42
39	4B	F0 4B
40	4C	F0 4C
41	52	F0 52
43	5A	F0 5A
44	12	F0 12
46	1A	F0 1A
47	22	F0 22
48	21	F0 21
49	2A	F0 2A
50	32	F0 32
51	31	F0 31
52	3A	F0 3A
53	41	F0 41
54	49	F0 49
55	4A	F0 4A
57	59	F0 59
58	14	F0 14
60	11	F0 11
61	29	F0 29
62	E0 11	E0 F0 11
64	E0 14	E0 F0 14

Key#	Make Code	Break Code
90	77	F0 77
91	6C	F0 6C
92	6B	F0 6B
93	69	F0 69
96	75	F0 75
97	73	F0 73
98	72	F0 72
99	70	F0 70
100	7C	F0 7C
101	7D	F0 7D
102	74	F0 74
103	7A	F0 7A
104	71	F0 71
105	7B	F0 7B
106	79	F0 79
110	76	F0 76
112	05	F0 05
113	06	F0 06
114	04	F0 04
115	0C	F0 0C
116	03	F0 03
117	0B	F0 0B
118	83	F0 83
119	0A	F0 0A
120	01	F0 01
121	09	F0 09
122	78	F0 78
123	07	F0 07
125	7E	F0 7E

Scan Code Set 2 (Part 2 of 5)

The following keys send a series of codes dependent on the state of the Shift Keys and the state of the Num Lock.

Key	Base Case, or Shift+Num Lk		Shift Case*		Num Lock on	
Number	Make	Break	Make	Break	Make	Break
75	E0 70	E0 F0 70	E0 F0 12 E0 70	E0 F0 70 E0 12	E0 12 E0 70	E0 F0 70 E0 F0 12
76	E071	E0 F0 71	E0 F0 12 E0 71	E0 F0 71 E0 12	E0 12 E0 71	E0 F0 71 E0 F0 12
79	E0 6B	E0 F0 6B	E0 F0 12 E0 6B	E0 F0 6B E0 12	E0 12 E0 6B	E0 F0 6B E0 F0 12
80	E0 6C	E0 F0 6C	E0 F0 12 E0 6C	E0 F0 6C E0 12	E0 12 E0 6C	E0 F0 6C E0 F0 12
81	E0 69	E0 F0 69	E0 F0 12 E0 69	E0 F0 69 E0 12	E0 12 E0 69	EO F0 69 E0 F0 12
83	E0 75	E0 F0 75	E0 F0 12 E0 75	E0 F0 75 E0 12	E0 12 E0 75	E0 F0 75 E0 F0 12
84	E0 72	E0 F0 72	E0 F0 12 E0 72	E0 F0 72 E0 12	E0 12 E0 72	E0 F0 72 E0 F0 12
85	E0 7D	E0 F0 7D	E0 F0 12 E0 7D	E0 F0 7D E0 12	E0 12 E0 7D	E0 F0 7D E0 F0 12
86	E0 7A	E0 F0 7A	E0 F0 12 E0 7A	E0 F0 7A E0 12	E0 12 E0 7A	E0 F0 7A E0 F0 12
89	E0 74	E0 F0 74	E0 F0 12 E0 74	E0 F0 74 E0 12	E0 12 E0 74	E0 F0 74 E0 F0 12

* If the left Shift Key is held down, the F0 12/12 shift make and break is sent with the other scan codes. If the right Shift Key is held down, F0/59/59 is sent. If both Shift Keys are down, both sets of codes are sent with the other scan codes.

Scan Code Set 2 (Part 3 of 5)

Key	Scan Code		Shift Case *	
Number	Make	Brake	Make	Brake
95	E0 4A	E0 FO 4A	E0 F0 12 E0 4A	E0 12 F0 4A

*If the left Shift Key is held down, the F0 12/12 shift make and break is sent with the other scan codes. If the right Shift Key is held down, F0 59/59 is sent. If both Shift Keys are down, both sets of codes are sent with the other scan codes.

Scan Code Set 2 (Part 4 of 5)

Key	Scan Code		Ctrl Case, Shift Case		Case	
Number	Make	Brake	Make	Brake	Make	Brake
124	E0 12 E0 7C	E0 F0 7C E0 F012	E0 7C	E0 F0 7C	84	F0 84

Scan Code Set 2 (Part 5 of 5)

Key Number	Make Code	Ctrl Key Pressed
126*	E1 14 77 E1 F0 14 F0 77	E0 7E E0 F0 7E

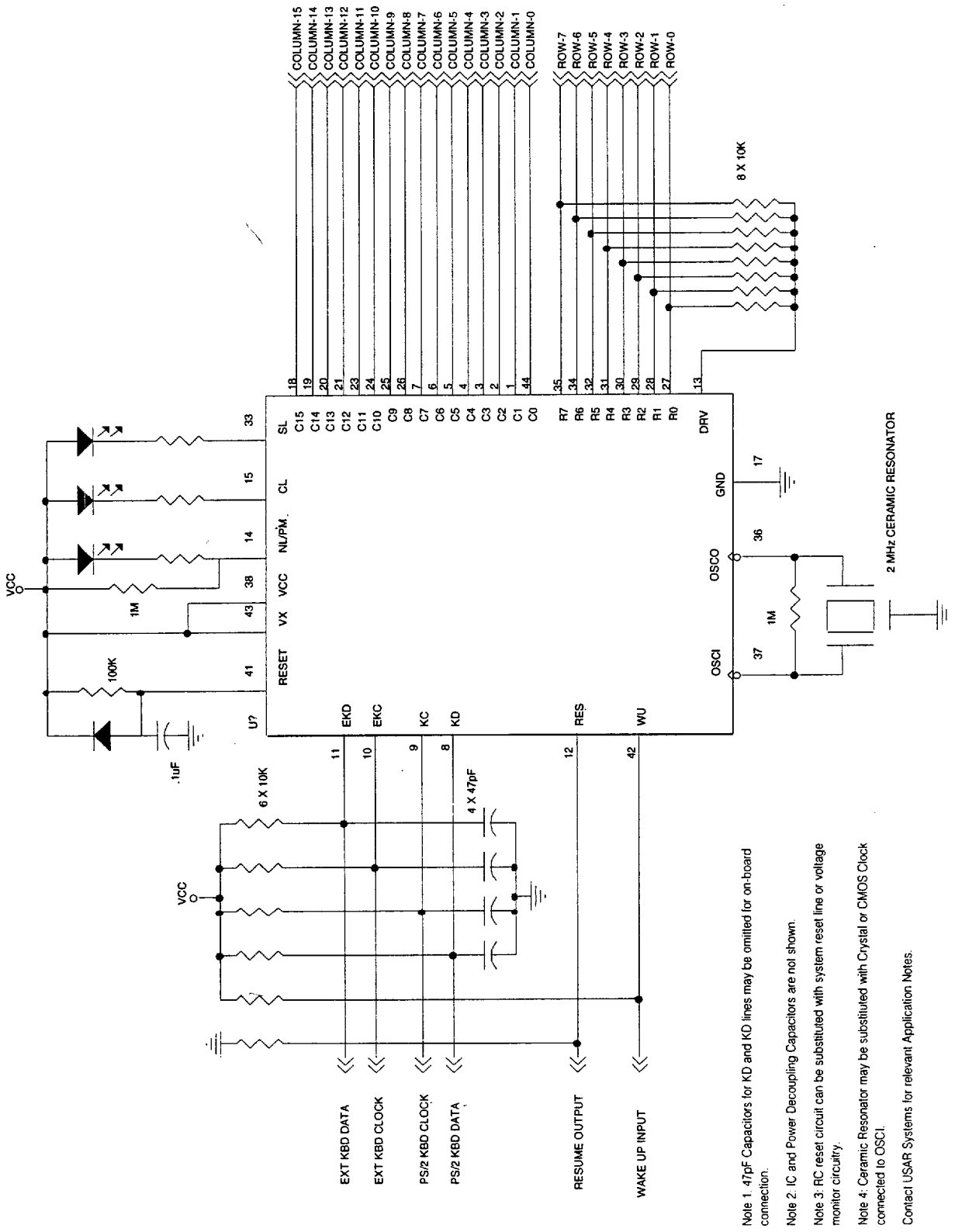
*This key is not Typematic. All associated scan codes occur on the make of the key.

Scan Code Set 3

Key Number	Make Code	Break Code	Default Key State
1	0E	F0 0E	Typematic
2	16	F0 16	Typematic
3	1E	F0 1E	Typematic
4	26	F0 26	Typematic
5	25	F0 25	Typematic
6	2E	F0 2E	Typematic
7	36	F0 36	Typematic
8	3D	F0 3D	Typematic
9	3E	F0 3E	Typematic
10	46	F0 46	Typematic
11	45	F0 45	Typematic
12	4E	F0 4E	Typematic
13	55	F0 55	Typematic
15	66	F0 66	Typematic
16	0D	F0 0D	Typematic
17	15	F0 15	Typematic
18	1D	F0 1D	Typematic
19	24	F0 24	Typematic
20	2D	F0 2D	Typematic
21	2C	F0 2C	Typematic
22	35	F0 35	Typematic
23	3C	F0 3C	Typematic
24	43	F0 43	Typematic
25	44	F0 44	Typematic
26	4D	F0 4D	Typematic
27	54	F0 54	Typematic
28	5B	F0 5B	Typematic
29	5C	F0 5C	Typematic
30	14	F0 14	Make/Break
31	1C	F0 1C	Typematic
32	1B	F0 1B	Typematic
33	23	F0 23	Typematic
34	2B	F0 2B	Typematic
35	34	F0 34	Typematic
36	33	F0 33	Typematic
37	3B	F0 3B	Typematic
38	42	F0 42	Typematic
39	4B	F0 4B	Typematic
40	4C	F0 4C	Typematic
41	52	F0 52	Typematic
43	5A	F0 5A	Typematic
44	12	F0 12	Make/Break
46	1A	F0 1A	Typematic
47	22	F0 22	Typematic
48	21	F0 21	Typematic
49	2A	F0 2A	Typematic
50	32	F0 32	Typematic
51	31	F0 31	Typematic
52	3A	F0 3A	Typematic
53	41	F0 41	Typematic

Key Number	Make Code	Break Code	Default Key State
54	49	F0 49	Typematic
55	4A	F0 4A	Typematic
57	59	F059	Make/Break
58	11	F0 11	Make/Break
60	19	F0 19	Make/Break
61	29	F0 29	Typematic
62	39	F0 39	Make only
64	58	F0 58	Make only
75	67	F0 67	Make only
76	64	F0 64	Typematic
79	61	F0 61	Typematic
80	6E	F0 6E	Make only
81	65	F0 65	Make only
83	63	F0 63	Typematic
84	60	F0 60	Typematic
85	6F	F0 6F	Make only
86	6D	F0 6D	Make only
89	6A	F0 6A	Typematic
90	76	F0 76	Make only
91	6C	F0 6C	Make only
92	6B	F0 6B	Make only
93	69	F0 69	Make only
95	77	F0 77	Make only
96	75	F0 75	Make only
97	73	F0 73	Make only
98	72	F0 72	Make only
99	70	F0 70	Make only
100	7E	F0 7E	Make only
101	7D	F0 7D	Make only
102	74	F0 74	Make only
103	7A	F0 7A	Make only
104	71	F0 71	Make only
105	84	F0 84	Make only
106	7C	F0 7C	Typematic
110	08	F0 08	Make only
112	07	F0 07	Make only
113	0F	F0 0F	Make only
114	17	F0 17	Make only
115	1F	F0 1F	Make only
116	27	F0 27	Make only
117	2F	F0 2F	Make only
118	37	F0 37	Make only
119	3F	F0 3F	Make only
120	47	F0 47	Make only
121	4F	F0 4F	Make only
122	56	F0 56	Make only
123	5E	F0 5E	Make only
124	57	F0 57	Make only
125	5F	F0 5F	Make only
126	62	F0 62	Make only

Suggested Interfacing



Note 1: 47pF Capacitors for KD and KD lines may be omitted for on-board connection.

Note 2: IC and Power Decoupling Capacitors are not shown.

Note 3: RC reset circuit can be substituted with system reset line or voltage monitor circuitry.

Note 4: Ceramic Resonator may be substituted with Crystal or CMOS Clock connected to OSCI.

Contact USAR Systems for relevant Application Notes.

Electrical Specifications

Absolute Maximum Ratings

Ratings	Symbol	Value	Unit
Supply Voltage	V_{DD}	-0.3 to +7.0	V
Input Voltage	V_{IN}	Vss -0.3 to V_{DD} +0.3	V
Current Drain per Pin (not including Vss or V_{DD})	I	25	mA
Operating Temperature UR5HCPLX-xx UR5HCPLX-Cxx	T_A	T low to T high 0 to +70 -40 to +85	° C
Storage Temperature Range	T_{STG}	-65 to +150	° C

Thermal Characteristics

Characteristic	Symbol	Value	Unit
Thermal Resistance ■ Plastic ■ PLCC	T_{JA}	 60 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)

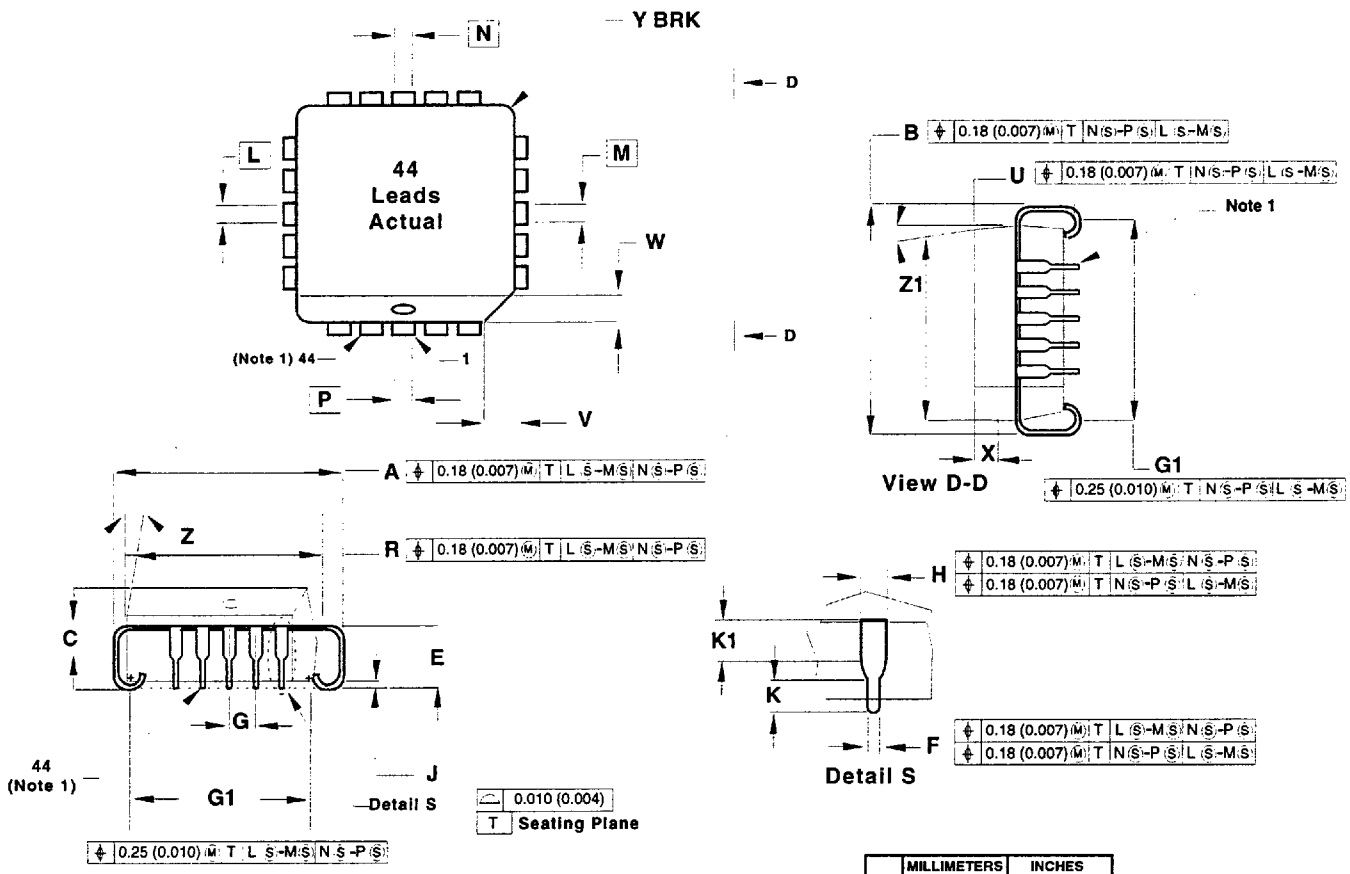
Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage (I_{LOAD}<10uA)	V_{OL} V_{OH}	 V_{DD}–0.1		0.1	V
Output High Voltage (I_{LOAD}=.0.8mA)	V_{OH}	V_{DD}–0.8			V
Output Low Voltage (I_{LOAD}=1.6mA)	V_{OL}:			0.4	V
Input High Voltage	V_{IH}	0.7xV_{DD}		V_{DD}	V
Input Low Voltage	V_{IL}	Vss		0.2xV_{DD}	V
User Mode Current	I_{PP}		5	10	mA
Data Retention Mode (0 to 70°C)	V_{RM}	2.0			V
Supply Current (Run)	I_{DD}		2.5	3.5	mA
(Wait)			0.8	1.5	mA
(Stop)			2.0	50	uA
I/O Ports Hi-Z Leakage Current	I_{IL}			+/-10	uA
Input Current	I_{IN}			+/- 1	uA
I/O Port Capacitance	C_{IO}		8	12	pF

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 ■ External Clock Option	fosc	 dc	 2.0 2.0	MHz
Cycle Time	tcyc	1000		ns
Crystal Oscillator Startup Time	t_{OXOV}		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
OSC1 Pulse 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.

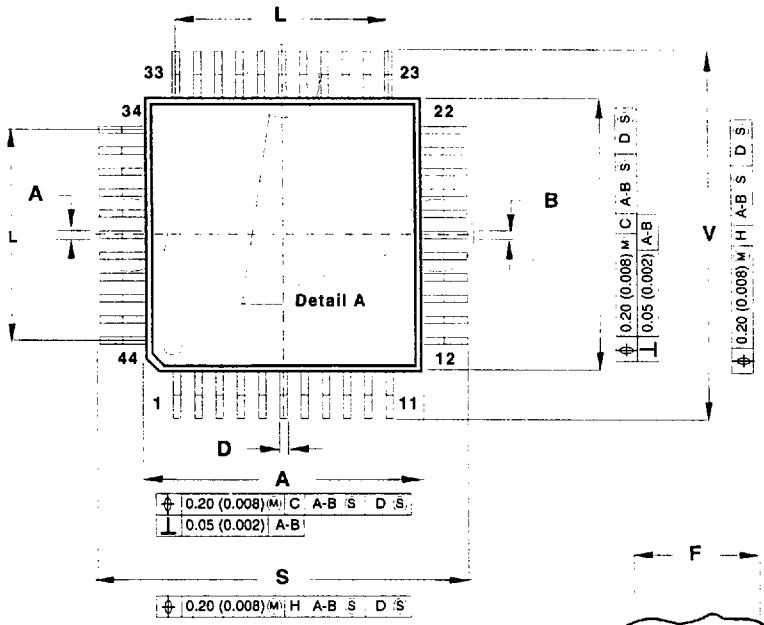
FN Suffix

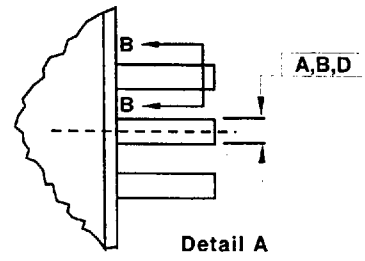


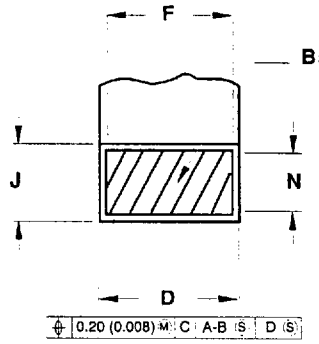
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	17.40	17.65	0.685	0.695
B	17.40	17.65	0.685	0.695
C	4.20	4.57	0.165	0.180
E	2.29	2.79	0.090	0.110
F	0.33	0.48	0.013	0.019
G	1.27 BSC		0.050 BSC	
H	0.66	0.81	0.026	0.032
J	0.51	-	0.020	-
K	0.64	-	0.025	-
R	16.51	16.66	0.650	0.656
U	16.51	16.66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

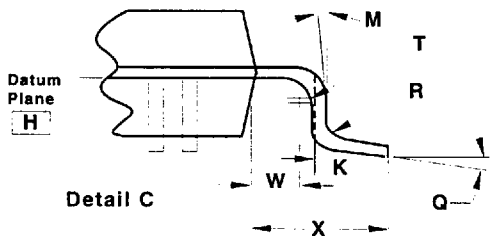
Notes:
1. **Due to space limitation, the chip is represented by a general (smaller) case outline drawing rather than showing all 44 leads.**
2. Datums L, M, N, and P determine where the top of the lead shoulder exits plastic body at mold parting line
3. DIM G1, true position to be measured at Datum T, 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

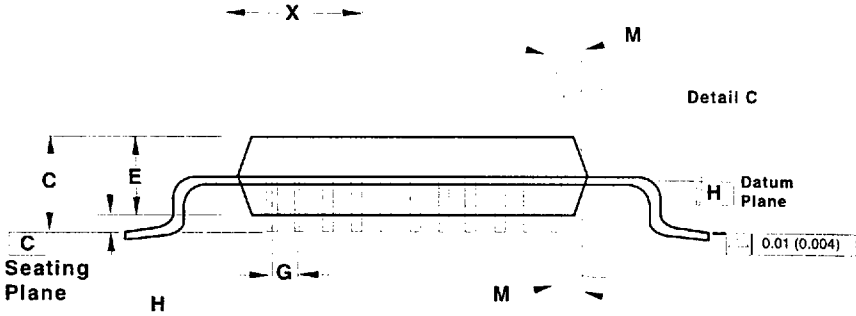
Quad Flat Package











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	