



**REALTEK**

**RTS5401**

**USB 3.0 Super-Speed HUB Controller**

**DATASHEET**

**Doc Rev. 0.90**  
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**REALTEK**

**Realtek Semiconductor Corp.**

No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan

Tel.: +886-3-578-0211. Fax: +886-3-577-6047

[www.realtek.com.tw](http://www.realtek.com.tw)

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## Revision History

Revision	Description	Page	Date
0.9	First release		2012/4/11

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## 1. General Description

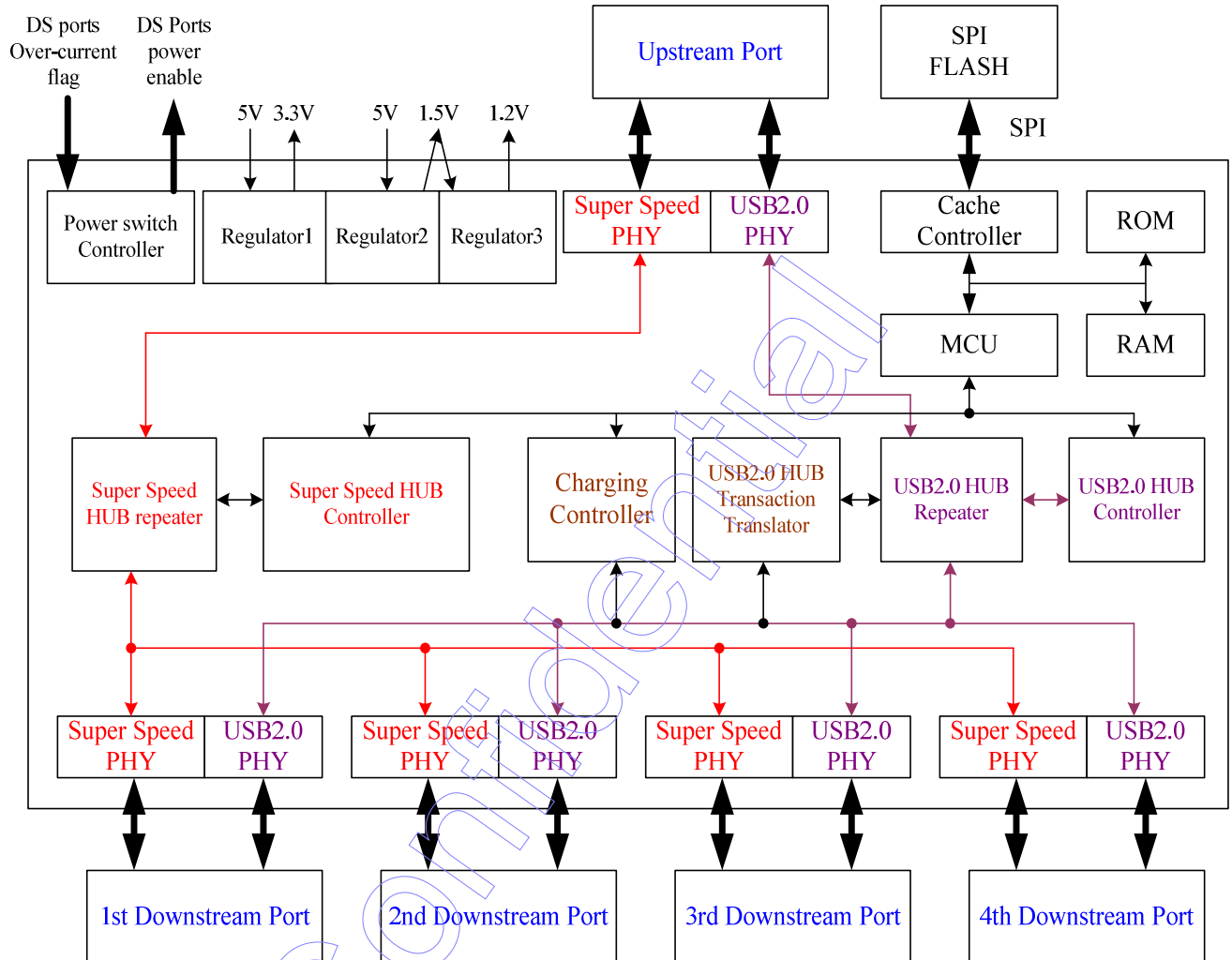
RTS5401 is a USB3.0 4-port super-speed HUB controller, which is single TT (Transaction Translator) solution and integrates USB3.0 and USB2.0 Transceivers, MCU, SIE and regulators into a single chip. That could dramatically reduce the system BOM cost. With the high compatibility, it is fully backward compatible to USB2.0 and USB1.1 specification which can be linked in Super Speed, High Speed or Full Speed operation.

RTS5401 provides the battery charging function for each downstream port. Not only complies with USB Battery Charging specification rev1.2 from USB-IF, RTS5401 also provides charging function for various Apple devices.

## 2. Features

- Compliant with Universal Serial Bus 3.0 Specification Revision 1.0
  - 4 downstream ports for super-speed, high-speed, full-speed and low-speed traffic
  - Backward compatible with USB specification Revision 2.0 and 1.1
  - Single TT architecture
  - Support Gang mode and Individual mode for downstream port over-current detection
- Compliant with USB Battery Charging Specification Revision 1.2
  - Charging Downstream Port
  - Dedicated Charging Port
- USB bus power / self power operation
- Support USB3.0 LTM function / USB2.0 LPM function and USB3.0 U1/U2/U3 power saving mode
- Integrated Fast 8051 microprocessor
- External Serial Flash memory interface for F/W update
- Support 12MHz Crystal clock
- On chip 5v to 3.3v, 5v to 1.5v and 1.5v to 1.2v regulators
- 76-pin QFN (9 x9 mm) package

### 3. Block Diagram



## 4. Pin Description

Pin#	Name	I/O Type	Description
1	RREF	I	Connect an external resistor ( $6.2K \pm 1\%$ ) to the Reference GND
2	BPWR_DET	I	Bus power detection pin
3	DV12	I	1.2V input to digital circuits
4	DV33	I	3.3V input to digital circuits
5	DSP2_DP	I/O	2 <sup>nd</sup> Downstream port USB2.0 D+ signal
6	DSP2_DM	I/O	2 <sup>nd</sup> Downstream port USB2.0 D- signal
7	AV12	I	1.2V input to analog circuits
8	DSP2_SSTX+	O	2 <sup>nd</sup> Downstream port USB3.0 SuperSpeed TX+
9	DSP2_SSTX-	O	2 <sup>nd</sup> Downstream port USB3.0 SuperSpeed TX-
10	OCP2	I	Over Current Protection flag for 2 <sup>nd</sup> downstream port
11	DSP2_SSRX+	I	2 <sup>nd</sup> Downstream port USB3.0 SuperSpeed RX+
12	DSP2_SSRX-	I	2 <sup>nd</sup> Downstream port USB3.0 SuperSpeed RX-
13	AV12	I	1.2V input to analog circuits
14	DSP3_SSTX+	O	3 <sup>rd</sup> Downstream port USB3.0 SuperSpeed TX+
15	DSP3_SSTX-	O	3 <sup>rd</sup> Downstream port USB3.0 SuperSpeed TX-
16	OCP3	I	Over Current Protection flag for 3 <sup>rd</sup> downstream port
17	DSP3_SSRX+	I	3 <sup>rd</sup> Downstream port USB3.0 SuperSpeed RX+
18	DSP3_SSRX-	I	3 <sup>rd</sup> Downstream port USB3.0 SuperSpeed RX-
19	AV12	I	1.2V input to analog circuits
20	DSP3_DP	I/O	3 <sup>rd</sup> Downstream port USB2.0 D+ signal
21	DSP3_DM	I/O	3 <sup>rd</sup> Downstream port USB2.0 D- signal
22	DV33	I	3.3V input to digital circuits
23	DSP4_DP	I/O	4 <sup>th</sup> Downstream port USB2.0 D+ signal
24	DSP4_DM	I/O	4 <sup>th</sup> Downstream port USB2.0 D- signal
25	AV12	I	1.2V input to analog circuits
26	DSP4_SSTX+	O	4 <sup>th</sup> Downstream port USB3.0 SuperSpeed TX+
27	DSP4_SSTX-	O	4 <sup>th</sup> Downstream port USB3.0 SuperSpeed TX-
28	OCP4	I	Over Current Protection flag for 4 <sup>th</sup> downstream port
29	DSP4_SSRX+	I	4 <sup>th</sup> Downstream port USB3.0 SuperSpeed RX+
30	DSP4_SSRX-	I	4 <sup>th</sup> Downstream port USB3.0 SuperSpeed RX-

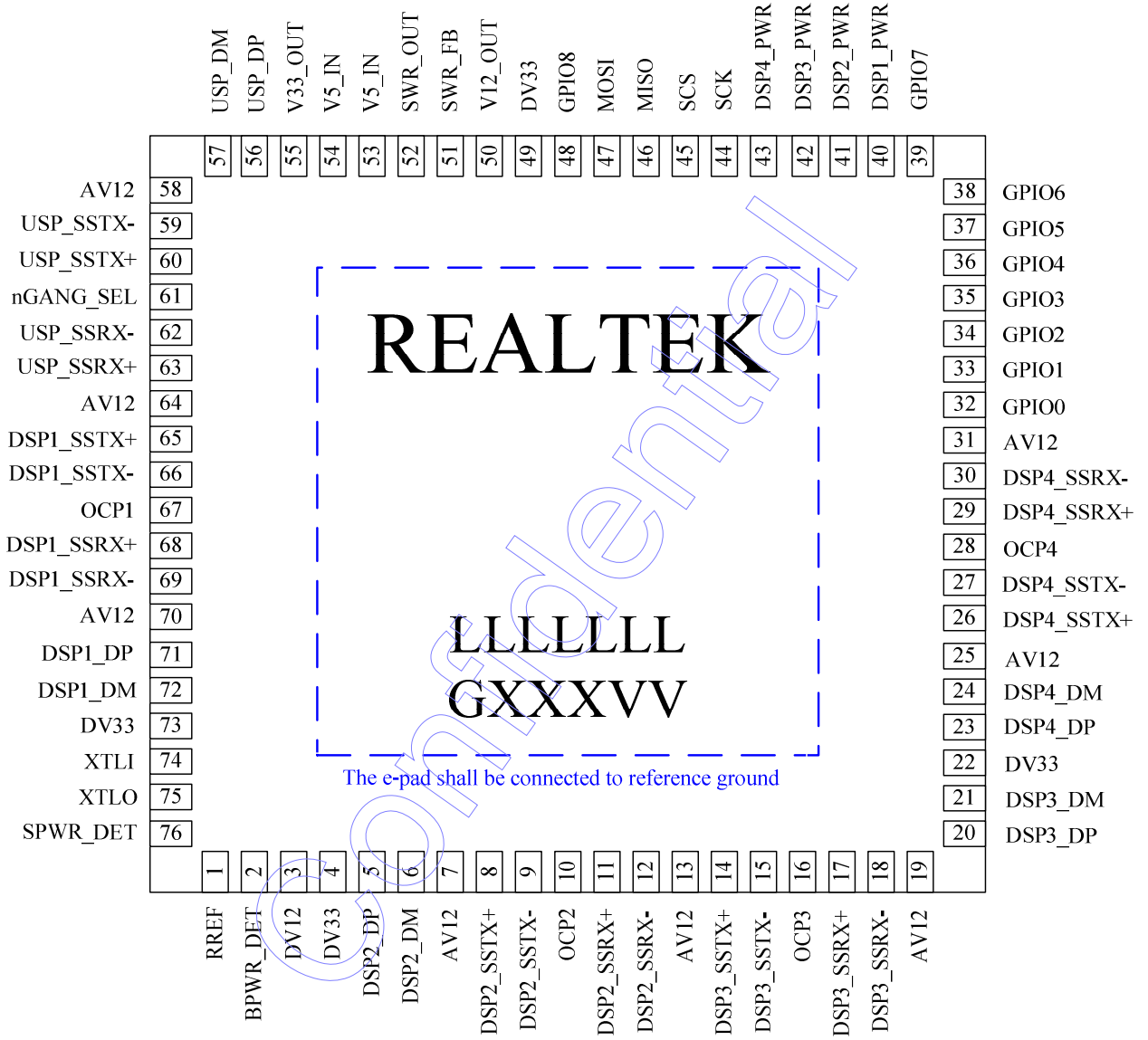
Pin#	Name	I/O Type	Description
31	AV12	I	1.2V input to analog circuits
32	GPIO0	I/O	General Purpose I/O. It is used for LED application
33	GPIO1	I/O	General Purpose I/O. It is used for LED application
34	GPIO2	I/O	General Purpose I/O. It is used for LED application
35	GPIO3	I/O	General Purpose I/O. It is used for LED application
36	GPIO4	I/O	General Purpose I/O. It is used for LED application
37	GPIO5	I/O	General Purpose I/O. It is used for LED application
38	GPIO6	I/O	General Purpose I/O. It is used for LED application
39	GPIO7	I/O	General Purpose I/O. It is used for LED application
40	DSP1_PWR	O	External power switch enable pin for Downstream port1
41	DSP2_PWR	O	External power switch enable pin for Downstream port2
42	DSP3_PWR	O	External power switch enable pin for Downstream port3
43	DSP4_PWR	O	External power switch enable pin for Downstream port4
44	SCK	I/O	This is I/O bi-direction. Now it is used as clock output for EEPROM or Serial Flash memory
45	SCS	I/O	This is I/O bi-direction. Now it is used as output chip select for EEPROM or Serial Flash memory
46	MISO	I/O	This is I/O bi-direction. Now it is used as data input from EEPROM or Serial Flash memory
47	MOSI	I/O	This is I/O bi-direction. Now it is used as data output to EEPROM or Serial Flash memory
48	GPIO8	I/O	General Purpose I/O. It is used for LED application
49	DV33	I	3.3V input to digital circuits
50	V12_OUT	O	1.2V output (from internal 1.5V to 1.2V regulator)
51	SWR_FB	I	1.5V SWR feedback to chip
52	SWR_OUT	O	5V to 1.5V SWR output
53	V5_IN	I	5V input (to internal 5V to 3.3V regulator)
54	V5_IN	I	5V input (to internal 5V to 3.3V regulator)
55	V33_OUT	O	3.3V output (from internal 5V to 3.3V regulator)
56	USP_DP	I/O	Upstream port USB2.0 D+ signal
57	USP_DM	I/O	Upstream port USB2.0 D- signal
58	AV12	I	1.2V input to analog circuits
59	USP_SSTX-	O	Upstream port USB3.0 SuperSpeed TX-
60	USP_SSTX+	O	Upstream port USB3.0 SuperSpeed TX+
61	nGANG_SEL	I	Gang or Individual mode selection (internal pull high) Logic 0: Gang mode, Logic 1: Individual mode
62	USP_SSRX-	I	Upstream port USB3.0 SuperSpeed RX-
63	USP_SSRX+	I	Upstream port USB3.0 SuperSpeed RX+
64	AV12	I	1.2V input to analog circuits
65	DSP1_SSTX+	O	Downstream port1 USB3.0 SuperSpeed TX+
66	DSP1_SSTX-	O	Downstream port1 USB3.0 SuperSpeed TX-

Pin#	Name	I/O Type	Description
67	OCP1	I	Over Current Protection flag for 1 <sup>st</sup> downstream port
68	DSP1_SSRX+	I	1 <sup>st</sup> Downstream port USB3.0 SuperSpeed RX+
69	DSP1_SSRX-	I	1 <sup>st</sup> Downstream port USB3.0 SuperSpeed RX-
70	AV12	I	1.2V input to analog circuits
71	DSP1_DP	I/O	1 <sup>st</sup> Downstream port USB2.0 D+ signal
72	DSP1_DM	I/O	1 <sup>st</sup> Downstream port USB2.0 D- signal
73	DV33	I	3.3V input to digital circuits
74	XTLI	I	12Mhz Crystal oscillator input
75	XTLO	O	12Mhz Crystal oscillator output
76	SPWR_DET	I	Self Power Detection pin
	E-PAD	GND	The bottom of the package has an expose-pad. The pad shall be connected to the reference ground

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### 5. Pin Assignment



The version number is shown in the location marked 'VV' and G means Green Package

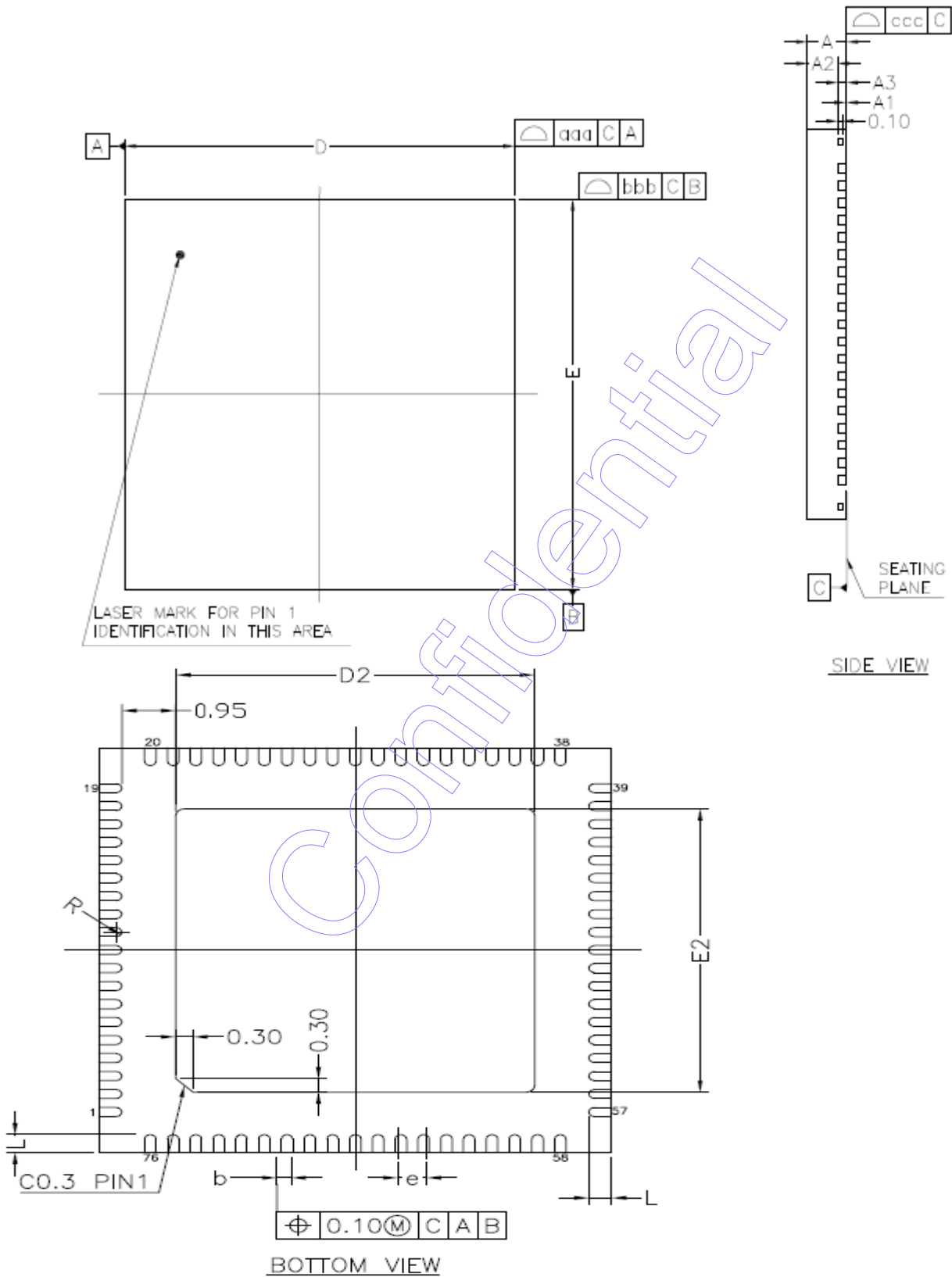
## 6. Electrical Characteristics

### 6.1 Absolute Maximum Ratings

Supply Voltage ..... -0.5V to +5.5V  
 Operating Temperature Range ..... 0°C to +70°C  
 Latch up Current ..... mA  
 Electrostatic Discharge Voltage (HBM)..... KV

### 6.2 DC Characteristics

Symbol	Description	Conditions	Min.	Typ.	Max.	Unit
V <sub>DD</sub>	Supply Voltage		4.5	5	5.5	V
V <sub>IH</sub>	Input Voltage High		2.0			V
V <sub>IL</sub>	Input Voltage Low				0.8	V
V <sub>OH</sub>	Output Voltage High		3.0			V
V <sub>OL</sub>	Output Voltage Low				0.4	V
C <sub>in</sub>	Input Pin Capacitance				10	pF
I <sub>DD</sub>	Supply Current	8051 is running @ 6MHz (Without memory card)		TBD		mA
I <sub>SUS</sub>	Suspend Current	D+ 1.5KΩ resistor is included		TBD		uA

**7. QFN-76 Package Dimensions**


\* CONTROLLING DIMENSION : MM

SYMBOL	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.85	0.90	0.031	0.033	0.035
A1	0.00	0.035	0.05	0.00	0.001	0.002
A2	---	0.65	0.70	---	0.026	0.028
A3	0.203 REF.			0.008 REF.		
b	0.15	0.20	0.25	0.006	0.010	0.010
D	9.00 bsc			0.354 bsc		
D2	6.20	6.30	6.40	0.244	0.248	0.252
E	9.00 bsc			0.354 bsc		
E2	6.20	6.30	6.40	0.244	0.248	0.252
L	0.35	0.40	0.45	0.014	0.016	0.018
e	0.40 bsc			0.016 bsc		
R	0.08	---	---	0.003	---	---
TOLERANCES OF FORM AND POSITION						
aaa	0.10			0.004		
bbb	0.10			0.004		
ccc	0.05			0.002		

NOTES :

- 1.ALL DIMENSIONS ARE IN MILLIMETERS.
- 2.DIE THICKNESS ALLOWABLE IS 0.305 mm MAXIMUM(.012 INCHES MAXIMUM)
- 3.DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. -1994.
- 4.THE PIN #1 IDENTIFIER MUST BE PLACED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR OTHER FEATURE OF PACKAGE BODY.
- 5.EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
- 6.PACKAGE WARPAGE MAX 0.08 mm.
- 7.APPLIED FOR EXPOSED PAD AND TERMINALS. EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
- 8.APPLIED ONLY TO TERMINALS.

## 8. Ordering Information

Part Number	Package	Status
RTS5401-GR	QFN-76 Green package	

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