1.8V to 5.5V RS-232 Single and Dual Transceivers

FEATURES

- **1.8V to 5.5V Supply Voltage**
- **Single and Dual Transceivers**
- **High-Speed Operation**
  - **1Mbps for 250pF/3kΩ Load (LTC2802, LTC2804)**
  - **250kbps for 1nF/3kΩ Load**
  - **100kbps for 2.5nF/3kΩ TIA/EIA-232-F Load**
- **Low-Power 1µA Shutdown and 15µA Receivers-Active Modes**
- No Damage or Latchup to ±10kV ESD on RS-232 Interface
- Logic Supply Pin for Easy Level-Shifting to UART or Microprocessor
- Low-Latency Output Enable Allows Line Sharing and Half-Duplex Operation
- True RS-232 Compliant Output Levels
- Small Footprint:
  - LTC2801/LTC2802 4mm × 3mm DFN Package
  - LTC2803/LTC2804 Narrow SSOP-16 and 5mm × 3mm DFN Packages

APPLICATIONS

- Battery-Powered Systems
- Computers and Consumer Electronics
- Diagnostic Ports

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DESCRIPTION

The LTC®2801/LTC2802/LTC2803/LTC2804 are single and dual RS-232 transceivers in narrow SSOP and chip-scale DFN packages. All operate over a supply range of 1.8V to 5.5V, which permits operation directly from two alkaline, NiCd or NiMH cells. An integrated DC-to-DC converter generates power supplies for driving RS-232 levels. A logic supply pin allows easy interfacing with different logic levels independent of the DC-DC supply.

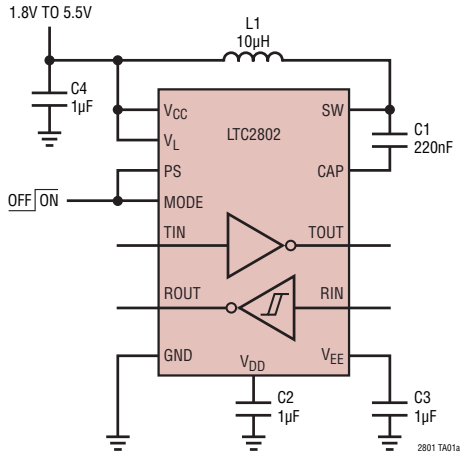
These parts are compatible with the TIA/EIA-232-F standard. Driver outputs are protected from overload and can be shorted to ground or up to ±15V without damage. To extend battery life, receivers can be kept active, operating at reduced speed, with only 15µA current. In shutdown mode, current is further reduced to 1µA.

PRODUCT SELECTION GUIDE

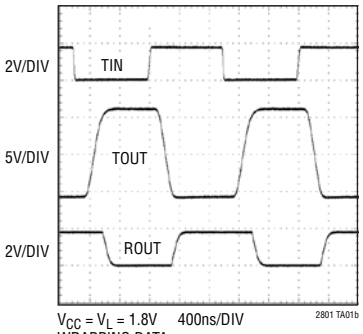
PART NUMBER	DRIVERS AND RECEIVERS	MAXIMUM DATA RATE	MODES*	PACKAGE
LTC2801	1 + 1	0.25Mbps	SD, RA, DD, AO	DFN-12
LTC2802	1 + 1	1Mbps	SD, RA, DD, AO	DFN-12
LTC2803	2 + 2	0.25Mbps	SD, RA, DD, AO	DFN-16
LTC2803-1	2 + 2	0.25Mbps	SD, AO	SSOP-16
LTC2804	2 + 2	1Mbps	SD, RA, DD, AO	DFN-16
LTC2804-1	2 + 2	1Mbps	SD, AO	SSOP-16

*SD = Shutdown, RA = Receiver Active (low power), DD = Drivers Disabled, AO = All On

TYPICAL APPLICATION



LTC2802 at 1.8V and 1Mbps



V_{CC} = V_L = 1.8V 400ns/DIV
WRAPPING DATA
TOUT LOAD = 250pF + RIN
ROUT LOAD = 150pF

ABSOLUTE MAXIMUM RATINGS (Note 1)

Input Supplies
- V_{CC} ..... –0.3V to 7V
- V_L ..... –0.3V to 6.7V

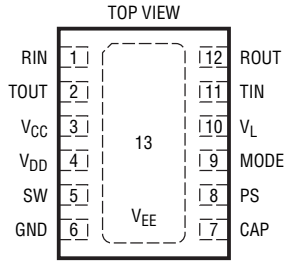
Generated Supplies
- V_{DD} ..... V_{CC} –0.3V to 7.5V
- V_{EE} ..... 0.3V to –7.5V
- $V_{DD} – V_{EE}$ 14V

SW ..... –0.3V to V_{DD} + 0.3V
CAP ..... +0.3V to V_{EE} – 0.3V
TIN, T1IN, T2IN, MODE ..... –0.3V to 7V
PS, ON/$\overline{OFF}$ ..... –0.3V to (V_L + 0.3V)
RIN, R1IN, R2IN ..... –25V to 25V
TOUT, T1OUT, T2OUT ..... –15V to 15V
ROUT, R1OUT, R2OUT ..... –0.3V to (V_L + 0.3V)
Operating Temperature
- LTC280XC ..... 0°C to 70°C
- LTC280XI ..... –40°C to 85°C

Storage Temperature Range ..... –65°C to 125°C
Lead Temperature (Soldering, 10 sec)
- GN Package ..... 300°C

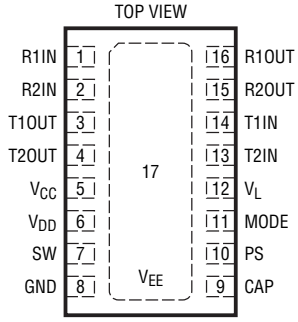
PIN CONFIGURATION

LTC2801, LTC2802
1-Driver/1-Receiver



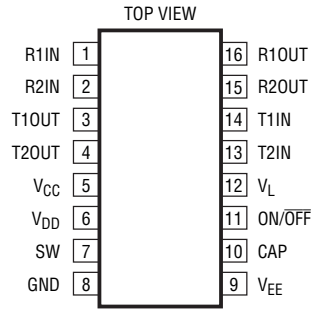
DE PACKAGE
12-LEAD (4mm × 3mm) PLASTIC DFN
T_{JMAX} = 125°C, θ_{JA} = 43°C/W, θ_{JC} = 4.3°C/W (4 Layer)
EXPOSED PAD (PIN 13) IS V_{EE}, MUST BE SOLDERED TO PCB

LTC2803, LTC2804
2-Driver/2-Receiver



DHC PACKAGE
16-LEAD (5mm × 3mm) PLASTIC DFN
T_{JMAX} = 125°C, θ_{JA} = 44°C/W, θ_{JC} = 4.3°C/W (4 Layer)
EXPOSED PAD (PIN 17) IS V_{EE}, MUST BE SOLDERED TO PCB

LTC2803-1, LTC2804-1
2-Driver/2-Receiver



GN PACKAGE
16-LEAD (NARROW 0.150) PLASTIC SSOP
T_{JMAX} = 125°C, θ_{JA} = 110°C/W, θ_{JC} = 40°C/W (4 Layer)

ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PART MARKING*	PACKAGE DESCRIPTION	TEMPERATURE RANGE
LTC2801CDE#PBF	LTC2801CDE#TRPBF	2801	12-Lead (4mm × 3mm) Plastic DFN	0°C to 70°C
LTC2801IDE#PBF	LTC2801IDE#TRPBF	2801	12-Lead (4mm × 3mm) Plastic DFN	–40°C to 85°C
LTC2802CDE#PBF	LTC2802CDE#TRPBF	2802	12-Lead (4mm × 3mm) Plastic DFN	0°C to 70°C
LTC2802IDE#PBF	LTC2802IDE#TRPBF	2802	12-Lead (4mm × 3mm) Plastic DFN	–40°C to 85°C
LTC2803CDHC#PBF	LTC2803CDHC#TRPBF	2803	16-Lead (5mm × 3mm) Plastic DFN	0°C to 70°C
LTC2803IDHC#PBF	LTC2803IDHC#TRPBF	2803	16-Lead (5mm × 3mm) Plastic DFN	–40°C to 85°C
LTC2804CDHC#PBF	LTC2804CDHC#TRPBF	2804	16-Lead (5mm × 3mm) Plastic DFN	0°C to 70°C
LTC2804IDHC#PBF	LTC2804IDHC#TRPBF	2804	16-Lead (5mm × 3mm) Plastic DFN	–40°C to 85°C
LTC2803CGN-1#PBF	LTC2803CGN-1#TRPBF	28031	16-Lead (Narrow 0.150) Plastic SSOP	0°C to 70°C
LTC2803IGN-1#PBF	LTC2803IGN-1#TRPBF	2803I1	16-Lead (Narrow 0.150) Plastic SSOP	–40°C to 85°C
LTC2804CGN-1#PBF	LTC2804CGN-1#TRPBF	28041	16-Lead (Narrow 0.150) Plastic SSOP	0°C to 70°C
LTC2804IGN-1#PBF	LTC2804IGN-1#TRPBF	2804I1	16-Lead (Narrow 0.150) Plastic SSOP	–40°C to 85°C

Consult LTC Marketing for parts specified with wider operating temperature ranges. *The temperature grade is identified by a label on the shipping container.
Consult LTC Marketing for information on non-standard lead based finish parts.

For more information on lead free part marking, go to: http://www.linear.com/leadfree/
For more information on tape and reel specifications, go to: http://www.linear.com/tapeandreel/

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C, V_{CC} = 1.8V to 5.5V, V_L = 1.8V to 5.5V, Normal Mode. Typical values are given for V_{CC} = V_L = 3.3V and T_A = 25°C, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Power Supplies							
I_{CC}	V_{CC} Supply Current	Outputs Unloaded					
		Normal Mode (Note 3)			2.3		mA
		Receivers Active Mode	●		1	10	µA
		Shutdown Mode	●		1	10	µA
I_L	V_L Supply Current	Outputs Unloaded					
		Normal Mode (LTC2801, LTC2802)	●		0.08	0.15	mA
		Normal Mode (LTC2803, LTC2804)	●		0.15	0.30	mA
		Receivers Active Mode	●		15	30	µA
		Shutdown Mode	●		1	10	µA
Driver							
V_{OLD}	Output Voltage	R_L = 3kΩ Low	●	–5	–5.7		V
V_{OHD}	Output Voltage	R_L = 3kΩ High	●	5	6.2		V
V_{HYSD}	Logic Input Hysteresis				0.6		V
I_{OSD}	Output Short Circuit Current	V_L = V_{CC} = 5.5V; V_{TOUT} = 0V	●		±35	±70	mA
I_{POLD}	Power-Off Output Leakage Current	V_L = V_{CC} = V_{DD} = V_{EE} = 0V; V_{TOUT} = ±2V	●		±0.1	±10	µA
I_{OLD}	Output Leakage Current	Shutdown or Receivers Active or Drivers Disabled Modes, –15V ≤ V_{TOUT} ≤ 15V	●		±0.1	±10	µA
Receiver							
V_{IR}	Input Thresholds	Receivers Active Mode	●	0.8	1.5	2.4	V
V_{ILR}	Input Thresholds	Normal Mode, Input Low	●	0.8	1.3		V
V_{IHR}	Input Thresholds	Normal Mode, Input High	●		1.7	2.5	V
V_{HYSR}	Input Hysteresis	Normal Mode	●	0.1	0.4	1.0	V
V_{OLR}	Output Voltage	Output Low, I_{ROUT} = 1mA (Sinking)	●		0.2	0.4	V
V_{OHR}	Output Voltage	Output High, I_{ROUT} = –1mA (Sourcing)	●	V_L –0.4	V_L –0.2		V
R_{IN}	Input Resistance	–15V ≤ V_{RIN} ≤ 15V	●	3	5	7	kΩ
I_{OSR}	Output Short Circuit Current	V_L = 5.5V; 0V ≤ V_{ROUT} ≤ V_L	●		±25	±50	mA
Logic							
	Logic Input Voltage Threshold		●	0.4		0.67 • V_L	V
I_{IN}	Logic Input Current		●			±1	µA
Power Supply Generator							
V_{DD}	Regulated V_{DD} Output Voltage	Driver R_L = 3kΩ (Note 3) LTC2801, LTC2802: V_{TIN} = V_L LTC2803, LTC2804: V_{T1IN} = V_L, V_{T2IN} = 0V			7		V
V_{EE}	Regulated V_{EE} Output Voltage	Driver R_L = 3kΩ (Note 3) LTC2801, LTC2802: V_{TIN} = V_L LTC2803, LTC2804: V_{T1IN} = V_L, V_{T2IN} = 0V			–6.3		V

SWITCHING CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C, V_{CC} = 1.8V to 5.5V, V_L = 1.8V to 5.5V, Normal Mode. Typical values are given for V_{CC} = V_L = 3.3V and T_A = 25°C, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
	Maximum Data Rate	LTC2801, LTC2803 (Note 3)					
		R_L = 3kΩ, C_L = 2.5nF	●	100			kbps
		R_L = 3kΩ, C_L = 1nF	●	250			kbps
		LTC2802, LTC2804 (Note 3)					
		R_L = 3kΩ, C_L = 2.5nF	●	100			kbps
		R_L = 3kΩ, C_L = 1nF	●	250			kbps
		R_L = 3kΩ, C_L = 250pF	●	1000			kbps
Driver							
SR(D)	Driver Slew Rate	LTC2801, LTC2803 (Figure 1)					
		V_{CC} = V_L = 1.8V, R_L = 3kΩ, C_L = 2.5nF	●	4			V/µs
		V_{CC} = V_L = 5.5V, R_L = 3kΩ, C_L = 50pF	●			30	V/µs
		LTC2802, LTC2804 (Figure 1)					
		V_{CC} = V_L = 1.8V, R_L = 3kΩ, C_L = 2.5nF	●	4			V/µs
		V_{CC} = V_L = 5.5V, R_L = 3kΩ, C_L = 50pF	●			150	V/µs
t_{PHLD}, t_{PLHD}	Driver Propagation Delay	R_L = 3kΩ, C_L = 50pF (Figure 2)					
		LTC2801, LTC2803	●		1	2	µs
		LTC2802, LTC2804	●		0.2	0.5	µs
t_{SKEWD}	Driver Skew	R_L = 3kΩ, C_L = 50pF (Figure 2)					
		LTC2801, LTC2803			100		ns
		LTC2802, LTC2804			50		ns
t_{PZHD}, t_{PZLD}	Driver Output Enable Time	PS = V_L, MODE = ↑, R_L = 3kΩ, C_L = 50pF (Figure 4)	●		0.6	2	µs
t_{PHZD}, t_{PLZD}	Driver Output Disable Time	PS = V_L, MODE = ↓, R_L = 3kΩ, C_L = 50pF (Figure 4)	●		0.3	2	µs
Receiver							
t_{PHLR}, t_{PLHR}	Receiver Propagation Delay	C_L = 150pF (Figure 3)	●		0.2	0.4	µs
t_{SKEWR}	Receiver Skew	C_L = 150pF (Figure 3)			50		ns
t_{RR}, t_{FR}	Receiver Rise or Fall Time	C_L = 150pF (Figure 3)	●		60	200	ns
t_{PZHR}, t_{PZLR}	Shutdown to Receiver Output Enable	PS = MODE = ↑ or ON/$\overline{OFF}$ = ↑, R_L = 1kΩ, C_L = 150pF (Figure 5)	●		5	15	µs
t_{PHZR}, t_{PLZR}	Receiver Output Disable upon Shutdown	PS = MODE = ↓ or ON/$\overline{OFF}$ = ↓, R_L = 1kΩ, C_L = 150pF (Figure 5)	●		0.15	0.3	µs
Power Supply Generator							
	V_{DD}/V_{EE} Supply Rise Time	(Notes 3 and 4)	●		0.2	2	ms

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: All currents into pins are positive; all voltages are referenced to GND unless otherwise specified.

Note 3: Guaranteed by other measured parameters and not tested directly.

Note 4: Time from PS ↑ or ON/$\overline{OFF}$ ↑ until $V_{DD} \geq 5V$ and $V_{EE} \leq -5V$.

TEST CIRCUITS

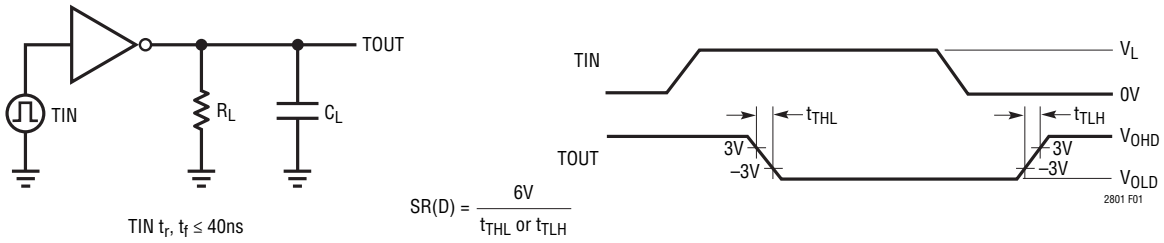


Figure 1. Driver Slew Rate Measurement

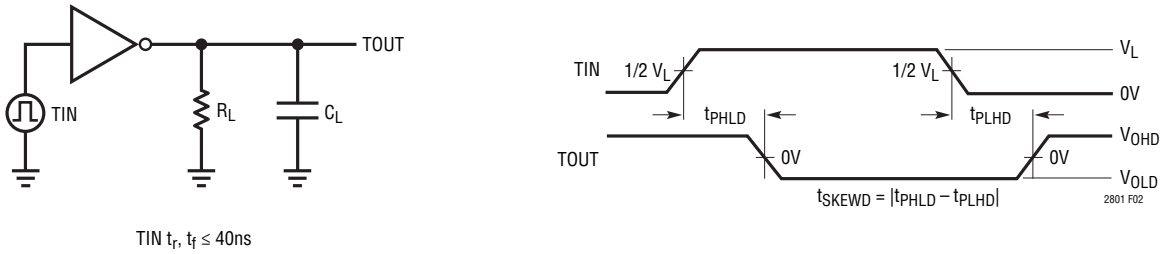


Figure 2. Driver Timing Measurement

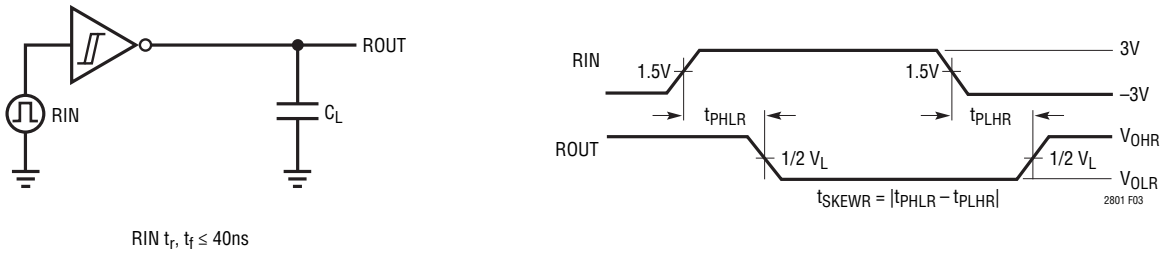


Figure 3. Receiver Timing Measurement

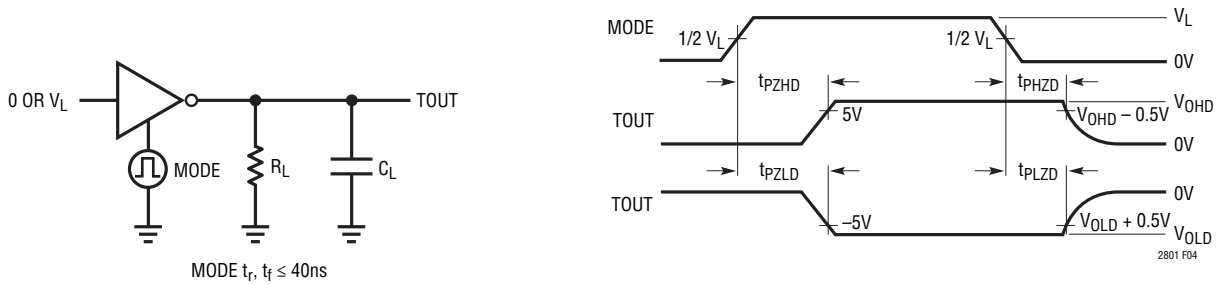


Figure 4. Driver Enable/Disable Times

TEST CIRCUITS

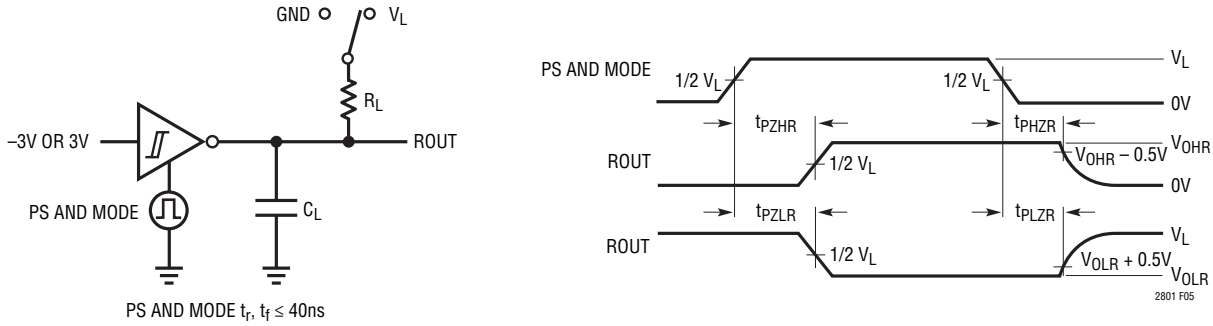
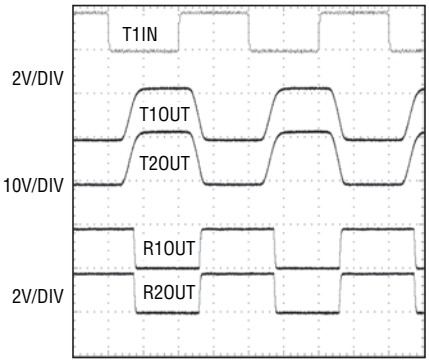


Figure 5. Receiver Enable/Disable Times

TYPICAL PERFORMANCE CHARACTERISTICS

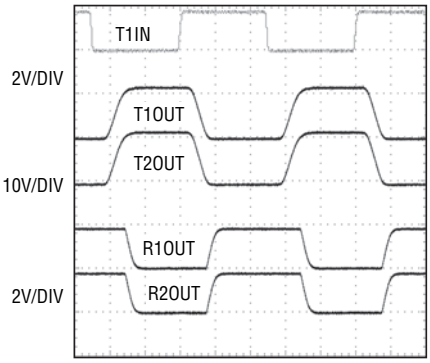
T_A = 25°C, V_{CC} = V_L = 3.3V unless otherwise noted.

LTC2803 at 1.8V and 250kbps



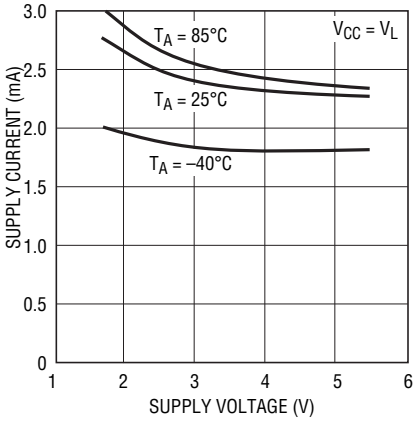
V_{CC} = V_L = 1.8V 2µs/DIV
WRAPPING DATA
TOUT LOAD = 1nF + RIN
ROUT LOAD = 150pF
2801 G01

LTC2804 at 1.8V and 1Mbps



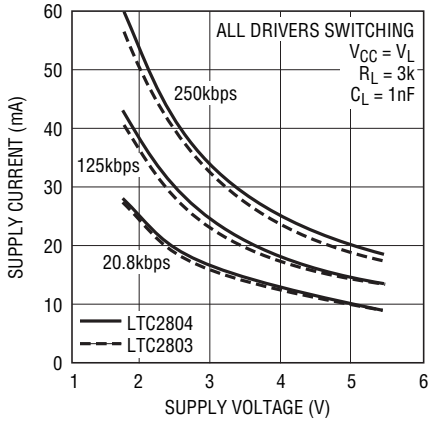
V_{CC} = V_L = 1.8V 400ns/DIV
WRAPPING DATA
TOUT LOAD = 250pF + RIN
ROUT LOAD = 150pF
2801 G02

Drivers Disabled Mode Supply Current vs Supply Voltage



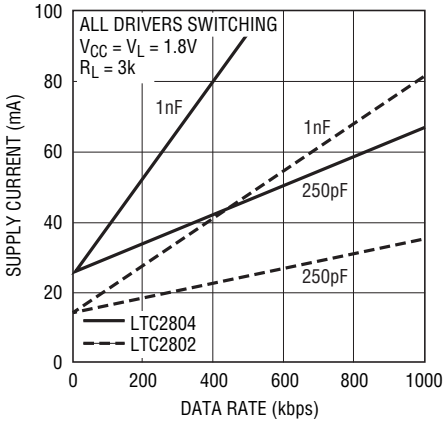
2801 G03

Supply Current vs Supply Voltage (Dual Transceiver)



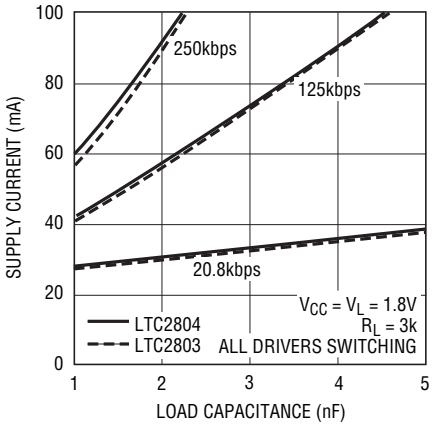
2801 G04

Supply Current vs Data Rate



2801 G05

Supply Current vs Load Capacitance (Dual Transceiver)

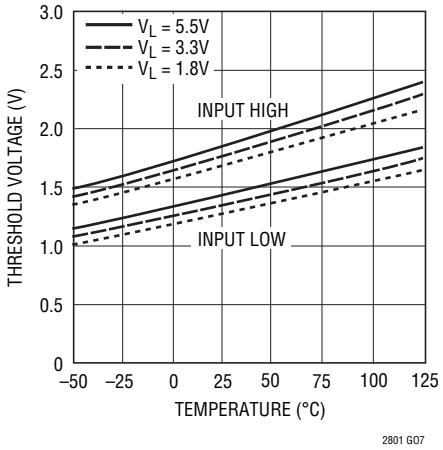


2801 G06

TYPICAL PERFORMANCE CHARACTERISTICS

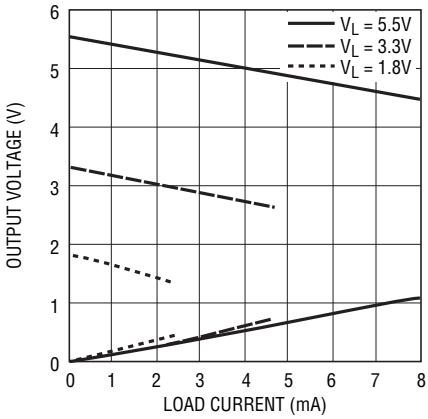
T_A = 25°C, V_{CC} = V_L = 3.3V unless otherwise noted.

Receiver Input Threshold vs Temperature



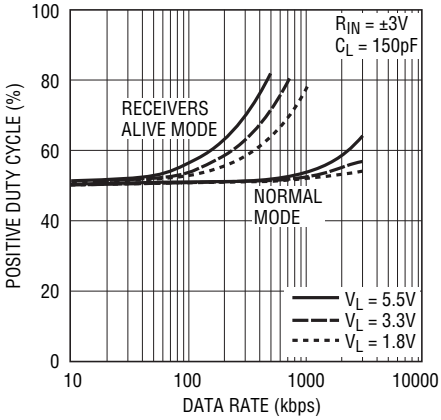
2801 GO7

Receiver Output Voltage vs Load Current



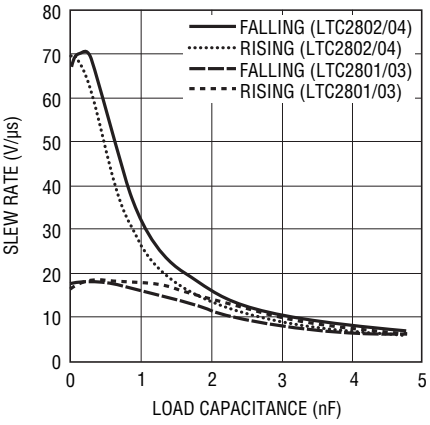
2801 GO8

Receiver Output Duty Cycle



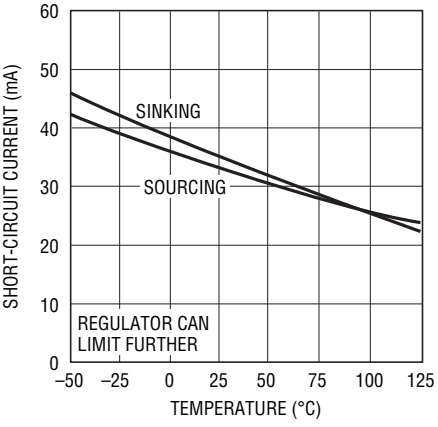
2801 GO9

Driver Slew Rate vs Load Capacitance



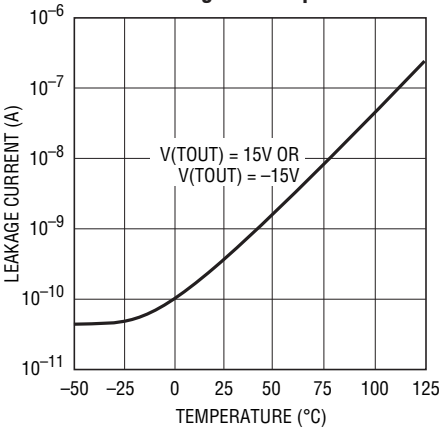
2801 G10

Driver Short-Circuit Current vs Temperature



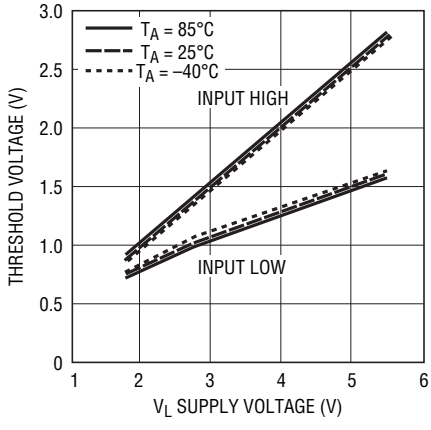
2801 G11

Shutdown or Drivers Disabled Mode Driver Leakage vs Temperature



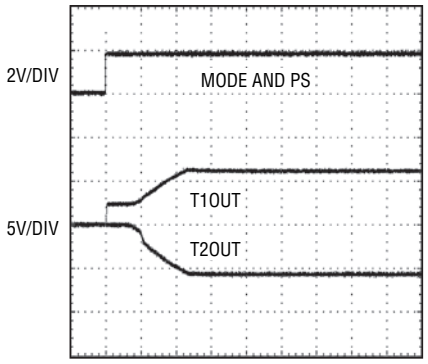
2801 G12

Logic Input Threshold vs V_L Supply Voltage



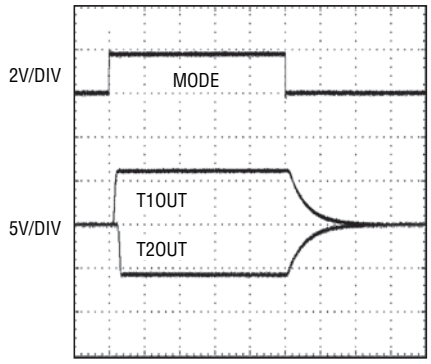
2801 G13

LTC2804 Driver Outputs Exiting Shutdown



2801 G14

LTC2804 Driver Outputs Enable/Disable



2801 G15

PIN FUNCTIONS

PIN NAME	PIN NUMBER 2801 2802	PIN NUMBER 2803 2804	PIN NUMBER 2803-1 2804-1	COMMENTS
V_{CC}	3	5	5	Input Supply (1.8V-5.5V). Bypass to GND with a 1µF capacitor.
V_{DD}	4	6	6	Generated Positive Supply Voltage for RS-232 Driver (7V). Connect a 1µF capacitor between V_{DD} and GND.
V_{EE}	13*	17*	9	Generated Negative Supply Voltage for RS-232 Driver (–6.3V). Connect a 1µF capacitor between V_{EE} and GND.
SW	5	7	7	Switch Pin. Connect a 10µH inductor between SW and V_{CC}.
GND	6	8	8	Ground.
CAP	7	9	10	Charge Pump Capacitor for Generated Negative Supply Voltage. Connect a 220nF capacitor between CAP and SW.
V_L	10	12	12	Logic Supply (1.8V-5.5V) for the receiver outputs, driver inputs, and control inputs. This pin should be bypassed to GND with a 220nF capacitor if it's not tied to V_{CC}.
TIN (T1IN, T2IN)	11	14, 13	14, 13	Driver Input(s), referenced to V_L.
TOUT (T1OUT, T2OUT)	2	3, 4	3, 4	RS-232 Driver Output(s).
RIN (R1IN, R2IN)	1	1, 2	1, 2	RS-232 Receiver Input(s). Includes internal 5kΩ termination resistor(s).
ROUT (R1OUT, R2OUT)	12	16, 15	16, 15	Receiver Output(s), referenced to V_L. Output is short-circuit protected to GND/V_{CC}/V_L, and is high impedance in Shutdown mode, allowing data line sharing.
PS	8	10	—	Power Supply control pin, referenced to V_L. Enables the integrated DC-DC converter.
MODE	9	11	—	Mode control pin, referenced to V_L. See Table 1 for functionality.
ON/$\overline{OFF}$	—	—	11	Transceiver enable pin, referenced to V_L. A logic low puts the device in Shutdown mode and places both driver and receiver outputs in a high impedance state.

*Backside thermal pad

MODE CONTROL

Table 1. LTC2801, LTC2802, LTC2803, LTC2804

MODE NAME	PS	MODE	RECEIVER OUTPUT(S)	DC-DC	DRIVER OUTPUT(S)	I_{VCC}*	I_{VL}*
SHUTDOWN	L	L	HI-Z	OFF	HI-Z	1µA	1µA
RECEIVER(S) ACTIVE	L	H	ON	OFF	HI-Z	1µA	15µA
DRIVER(S) DISABLED	H	L	ON	ON	HI-Z	2.1mA	80µA OR 150µA
NORMAL	H	H	ON	ON	ON	2.3mA	80µA OR 150µA

Table 2. LTC2803-1, LTC2804-1

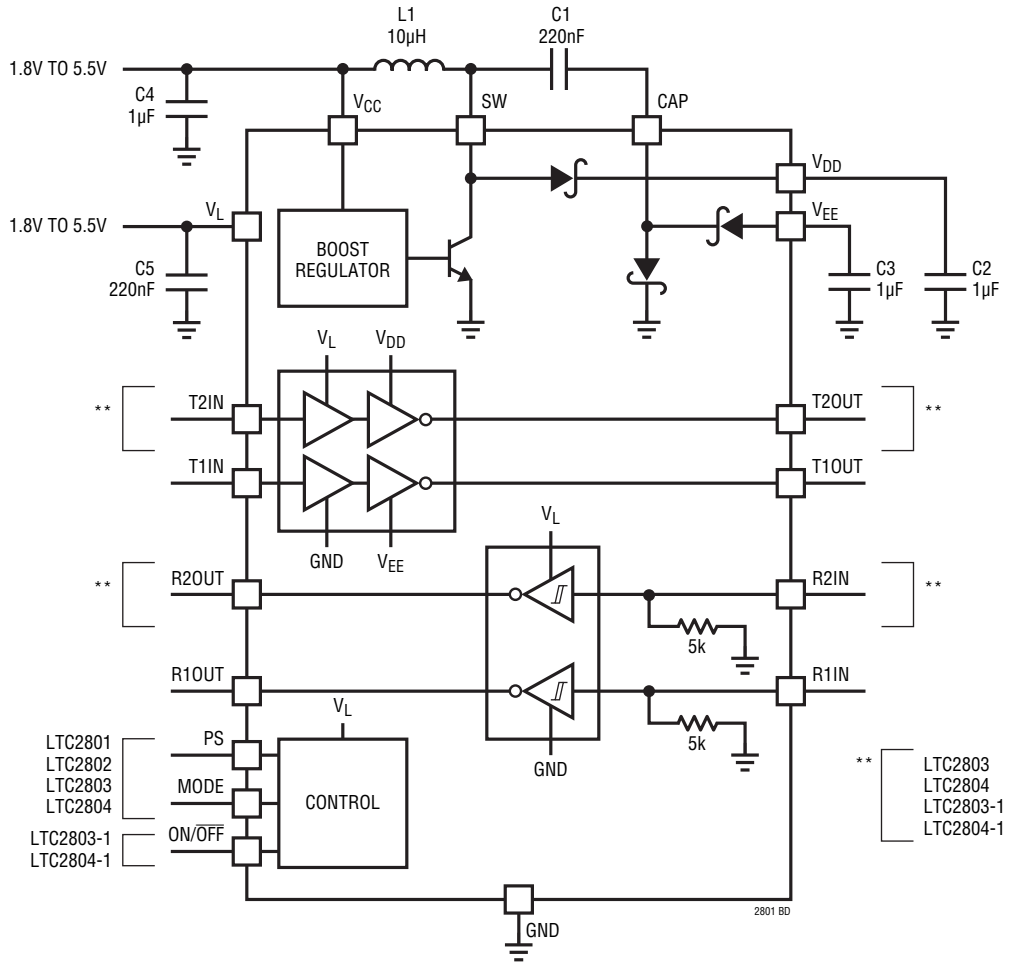
MODE NAME	ON/$\overline{OFF}$	RECEIVER OUTPUTS	DC-DC	DRIVER OUTPUTS	I_{VCC}*	I_{VL}*
SHUTDOWN	L	HI-Z	OFF	HI-Z	1µA	1µA
NORMAL	H	ON	ON	ON	2.3mA	150µA

*Typical currents for static drivers. Normal mode currents are for unloaded outputs.

FEATURE SUMMARY

FEATURE	2801	2802	2803	2803-1	2804	2804-1
DRIVERS and RECEIVERS	1 + 1	1 + 1	2 + 2	2 + 2	2 + 2	2 + 2
PACKAGE	DFN-12	DFN-12	DFN-16	SSOP-16	DFN-16	SSOP-16
1.8V - 5.5V OPERATION	●	●	●	●	●	●
1.8V - 5.5V LOGIC SUPPLY (V_L)	●	●	●	●	●	●
SHUTDOWN (1µA)	●	●	●	●	●	●
RECEIVER(S) ACTIVE (15µA)	●	●	●		●	
DRIVER(S) DISABLE	●	●	●		●	
100kb/s for R_L = 3kΩ, C_L = 2.5nF	●	●	●	●	●	●
250kb/s for R_L = 3kΩ, C_L = 1nF	●	●	●	●	●	●
1Mb/s for R_L = 3kΩ, C_L = 250pF		●			●	●

BLOCK DIAGRAM



APPLICATIONS INFORMATION

Overview

The LTC2801 family of RS-232 transceivers operates on a V_{CC} supply of 1.8V to 5.5V, utilizing a switching regulator to generate the necessary higher voltage rails for the drivers. The transceivers interface with logic operating on any supply from 1.8V to 5.5V, independent of the V_{CC} voltage. Depending on the device, one or two control pins are available to invoke Shutdown, Receiver Active and Driver Disable features.

DC-DC Converter

The on-chip DC-DC converter operates from the V_{CC} input, generating a 7V V_{DD} supply and a charge pumped –6.3V V_{EE} supply, as shown in Figure 6. V_{DD} and V_{EE} power the output stage of the drivers and are regulated to levels that guarantee greater than ±5V output swing. The DC-DC converter requires a 10µH inductor (L1) and a bypass capacitor (C4) of at least 1µF. The recommended size for the charge pump capacitor (C1) is 220nF and for the storage capacitors (C2 and C3) is 1µF. Larger storage capacitors up to 4.7µF may be used if C1 is kept at 20% to 50% their size and C4 is also scaled. Locate C1-C4 close to their associated pins.

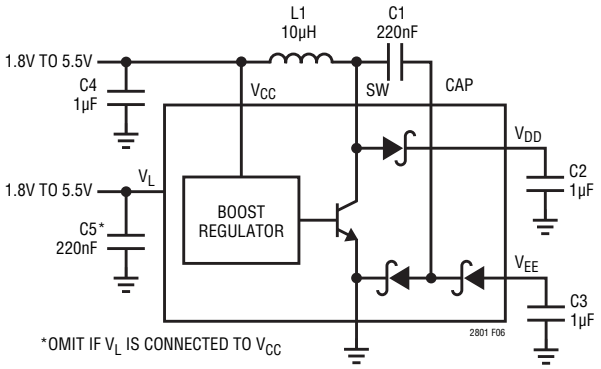


Figure 6. DC/DC Converter and Recommended Bypassing

V_L Logic Supply

A separate logic supply pin V_L allows the LTC2801 family to interface with any logic signal from 1.8V to 5.5V, as shown in Figure 7. Simply connect the desired logic supply to V_L. There is no interdependency between V_{CC} and V_L; they may simultaneously operate at any voltage from 1.8V to 5.5V and sequence in any order. If V_L is powered separately from V_{CC}, bypass V_L with a 220nF capacitor (C5).

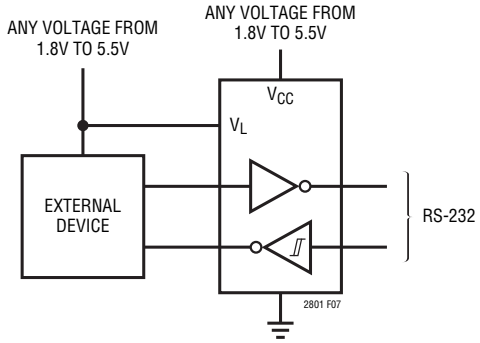


Figure 7. V_{CC} and V_L Are Independent

Power-Saving Modes

When the DC-DC converter and drivers are turned off (PS and MODE or ON/$\overline{OFF}$ = logic low), V_{CC} supply current is reduced to 1µA. Tables 1 and 2 summarize the modes for each device.

In Shutdown mode, V_L supply current is reduced to 1µA, and both receiver and driver outputs assume a high impedance state.

In Receivers Active mode, the quiescent V_L supply current is reduced to 15µA and the driver outputs assume a high impedance state. The receivers operate at a reduced rate (typically 100 kbps) with hysteresis turned off.

Half-Duplex Operation

When the DC-DC converter is kept on (PS = logic high), MODE serves as a low-latency driver enable for half-duplex operation. Each driver is enabled and disabled in less than 2µs, while each receiver remains continuously active. This mode of operation is illustrated in Figures 15-17.

Battery Operation

To maximize battery life, connect V_{CC} (and L1) directly to the unregulated battery voltage and V_L to the regulated supply, as shown in Figure 22. This configuration typically minimizes conversion loss while providing compatibility with system logic levels.

Inductor Selection

A 10µH inductor with a saturation current (I_{SAT}) rating of at least 200mA and low DCR (copper wire resistance) is recommended. Some small inductors meeting these requirements are listed in Table 3.

APPLICATIONS INFORMATION

Table 3. Recommended Inductors

PART NUMBER	I_{SAT} (mA)	MAX DCR (Ω)	SIZE (mm)	MANUFACTURER
LQH2MCN100K02L	225	1.2	2 × 1.6 × 0.95	Murata www.murata.com
LBC2016T100K	245	0.85	2 × 1.6 × 1.6	Taiyo Yuden www.t-yuden.com
FSLB2520-100K	220	1.1	2.5 × 2 × 1.6	Toko www.tokoam.com

Capacitor Selection

The small size of ceramic capacitors makes them ideal for the LTC2801 family. X5R and X7R (preferred) types are recommended because their ESR is low and they retain their capacitance over relatively wide voltage and temperature ranges. Use a voltage rating of at least 10V.

Table 4. Recommended Ceramic Capacitor Manufacturers

MANUFACTURER	URL
Murata	www.murata.com
TDK	www.tdk.com
Taiyo Yuden	www.t-yuden.com
AVX	www.avxcorp.com
Kemet	www.kemet.com

Inrush Current and Supply Overshoot Precaution

In certain applications, such as battery-operated and wall-adapter devices, fast supply slew rates are generated when power is connected. If V_{CC}'s voltage is greater than 4.5V and its rise time is faster than 10µs, the pins V_{DD} and SW can exceed their ABS MAX values during start-up. When supply voltage is applied to V_{CC}, the voltage difference between V_{CC} and V_{DD} generates inrush current flowing through inductor L1 and capacitors C1, C2. The peak inrush current must not exceed 2A. To avoid this condition, add a 1Ω resistor as shown in Figure 8. This precaution is not relevant for supply voltages below 4.5V or rise times longer than 10µs.

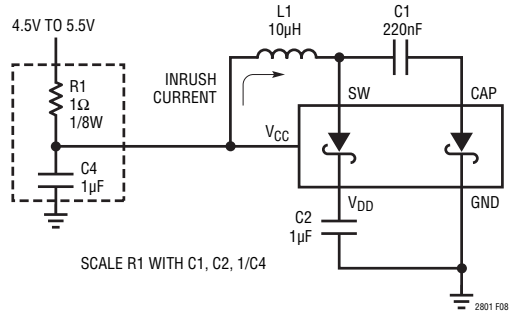


Figure 8. Supply Overshoot Protection for Input Supplies of 4.5V or Higher

Board Layout

The board layout should minimize the length and area of the SW and CAP traces. Suggested compact layouts for the LTC2801 family are shown in Figure 9 (a) and (b).

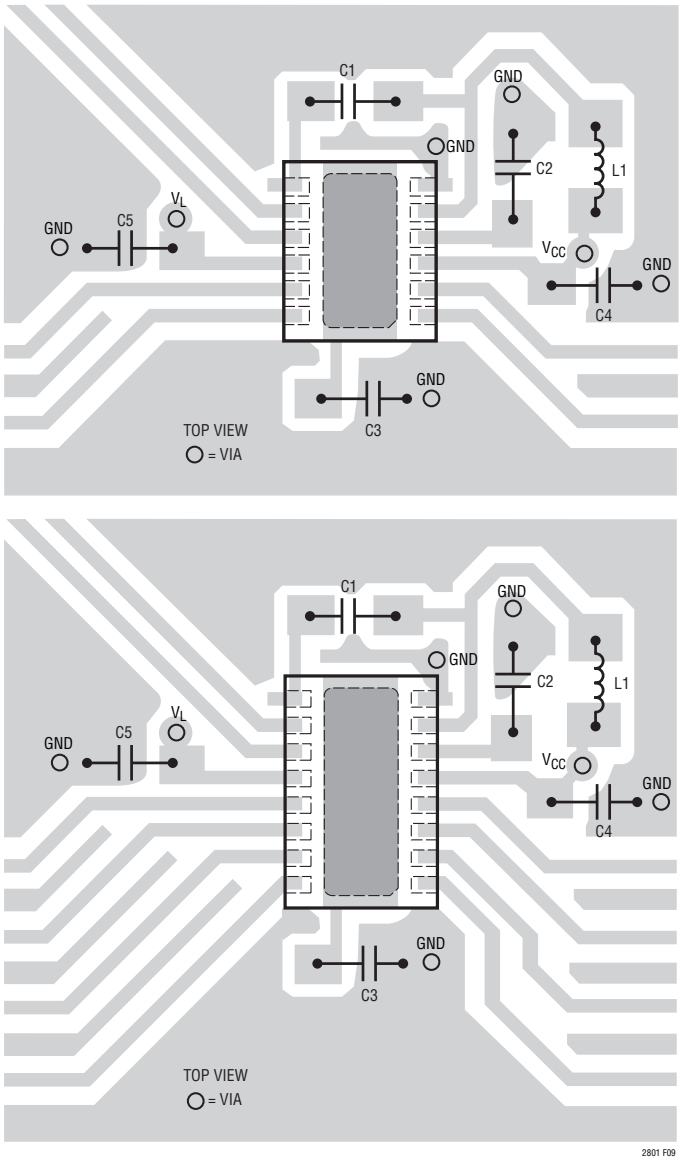


Figure 9. Recommended Board Layouts for (a) Single and (b) Dual Transceiver Parts

TYPICAL APPLICATIONS

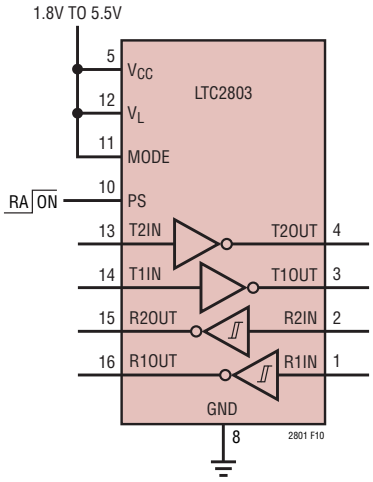


Figure 10. Power-Saving Receivers-Active Mode

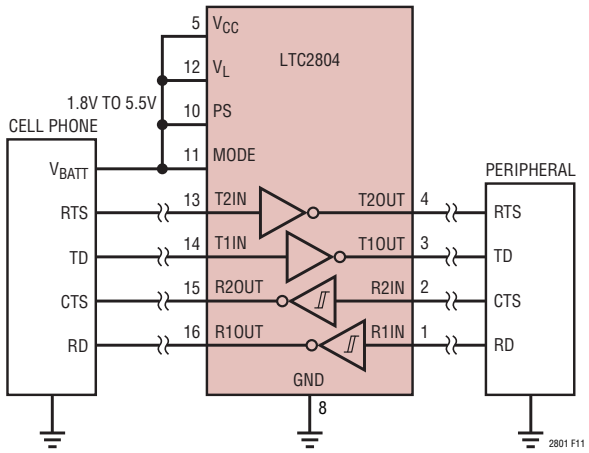


Figure 11. Cellphone Peripheral Interface

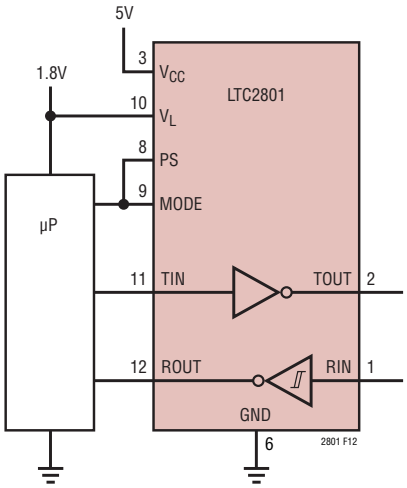


Figure 12. 1.8V Microprocessor Interface

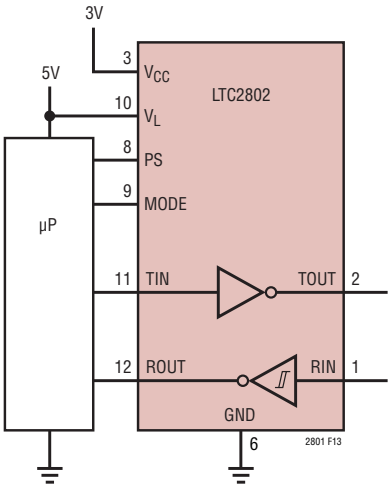


Figure 13. 5V Microprocessor Interface

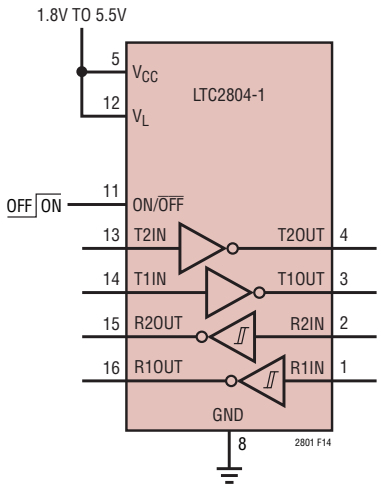


Figure 14. Power-Saving Shutdown Mode

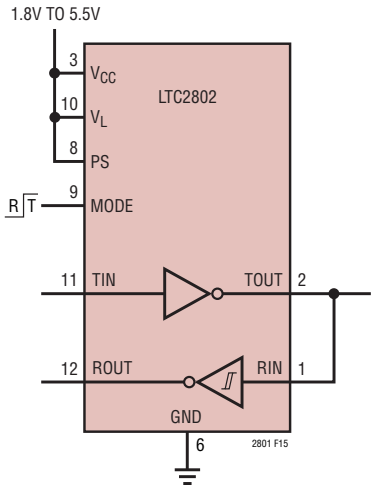


Figure 15. Half-Duplex on Single Line, Separate ROUT, TIN

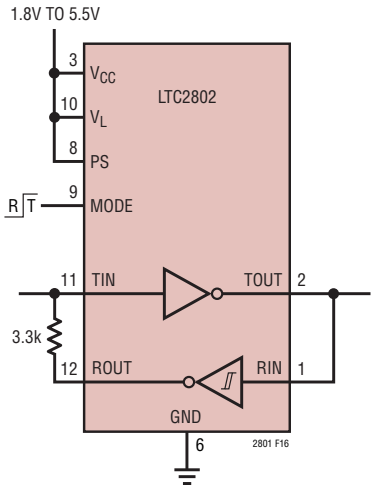


Figure 16. Half-Duplex on Single Line

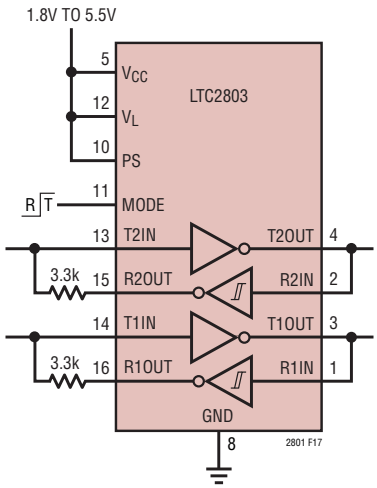
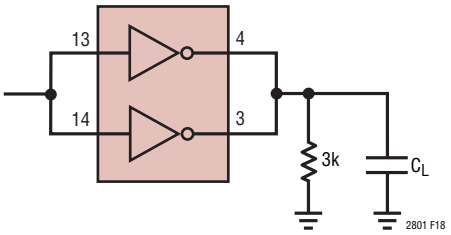


Figure 17. Half-Duplex Dual Transceiver

TYPICAL APPLICATIONS



DATA RATE (kbps)	C_L (nF)	LTC2803	LTC2804
100	5	X	X
250	2	X	X
1000	0.5		X

Figure 18. Driving Larger Loads

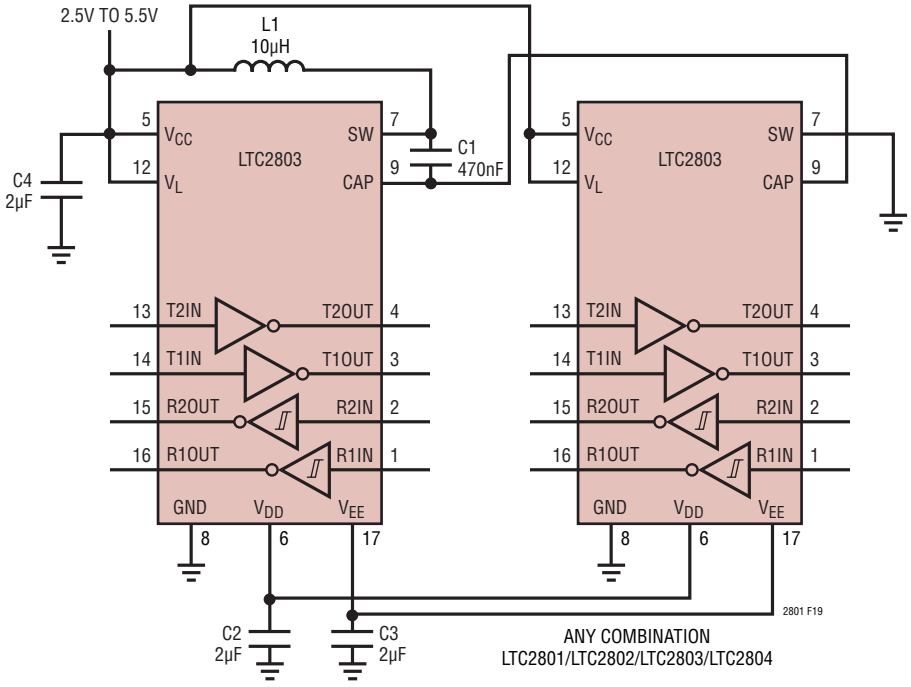
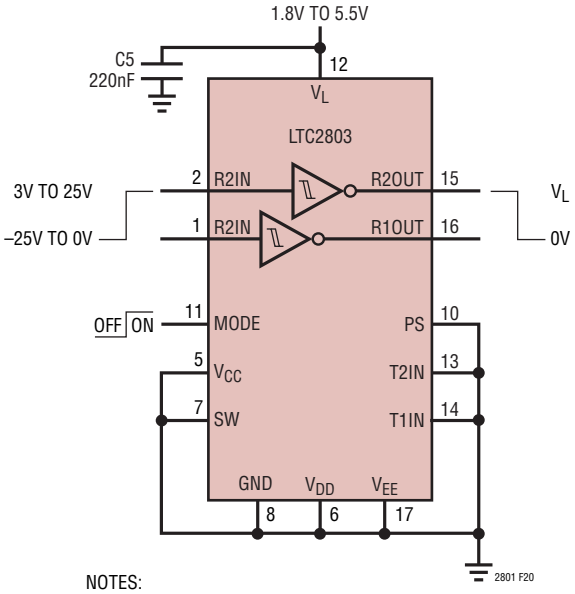


Figure 19. Quad Transceiver (2.5V < V_{CC} < 5.5V)



NOTES:
1. NO L1 OR C2-C4 NEEDED.
2. RECEIVERS ACTIVE MODE SHOWN HAS NO DC HYSTERESIS.
3. SEE DUTY CYCLE GRAPH IN TYPICAL PERFORMANCE SECTION.

Figure 20. 100kbps Dual Inverting Level Translator (I_L = 15µA Static)

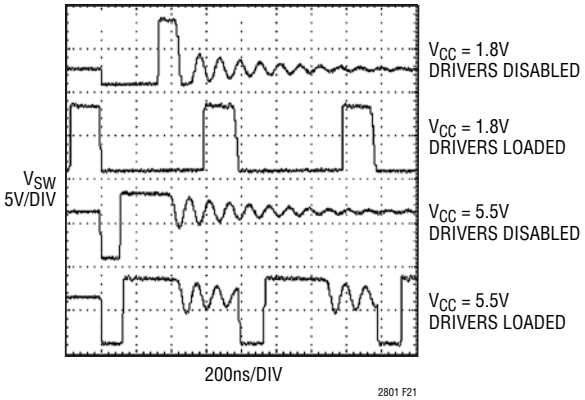
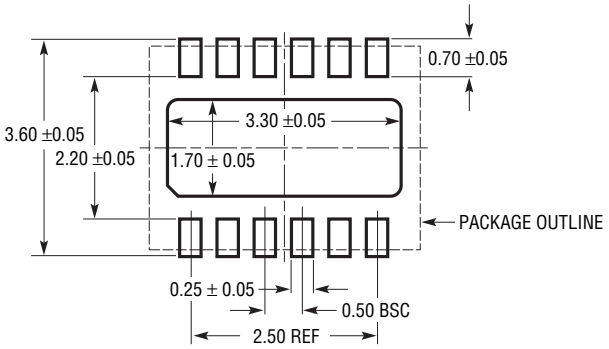


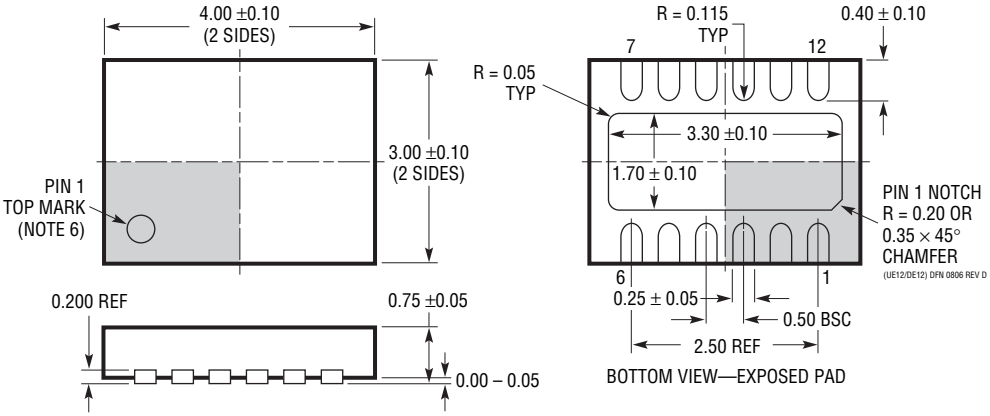
Figure 21. Typical SW Pin Waveforms

PACKAGE DESCRIPTION

DE/UE Package
12-Lead Plastic DFN (4mm × 3mm)
(Reference LTC DWG # 05-08-1695 Rev D)



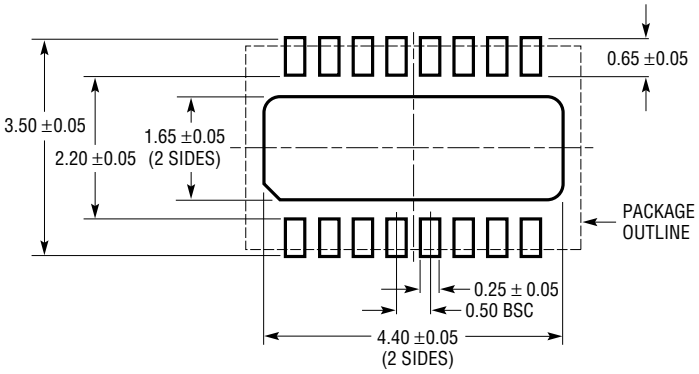
RECOMMENDED SOLDER PAD PITCH AND DIMENSIONS
APPLY SOLDER MASK TO AREAS THAT ARE NOT SOLDERED



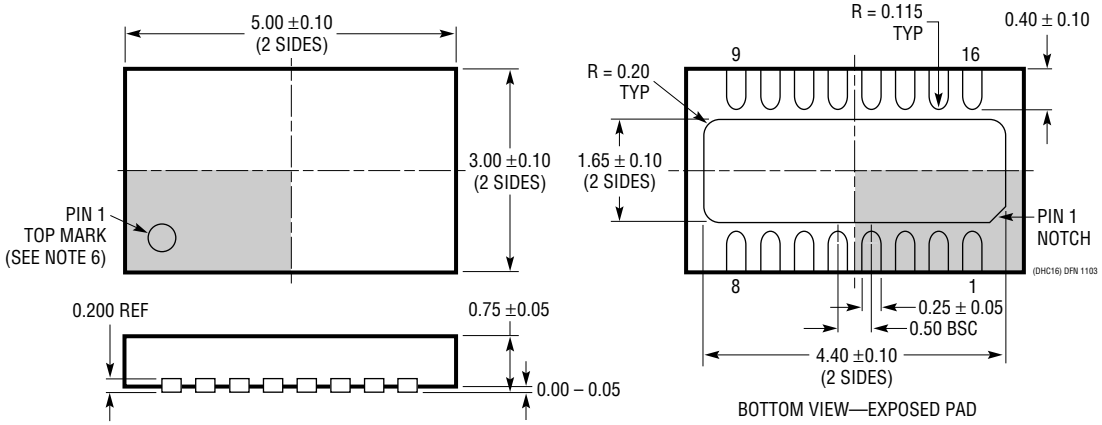
NOTE:
1. DRAWING PROPOSED TO BE A VARIATION OF VERSION
   (WGED) IN JEDEC PACKAGE OUTLINE M0-229
2. DRAWING NOT TO SCALE
3. ALL DIMENSIONS ARE IN MILLIMETERS
4. DIMENSIONS OF EXPOSED PAD ON BOTTOM OF PACKAGE DO NOT INCLUDE
   MOLD FLASH. MOLD FLASH, IF PRESENT, SHALL NOT EXCEED 0.15mm ON ANY SIDE
5. EXPOSED PAD SHALL BE SOLDER PLATED
6. SHADED AREA IS ONLY A REFERENCE FOR PIN 1 LOCATION
   ON THE TOP AND BOTTOM OF PACKAGE

PACKAGE DESCRIPTION

DHC Package
16-Lead Plastic DFN (5mm × 3mm)
(Reference LTC DWG # 05-08-1706)



RECOMMENDED SOLDER PAD PITCH AND DIMENSIONS

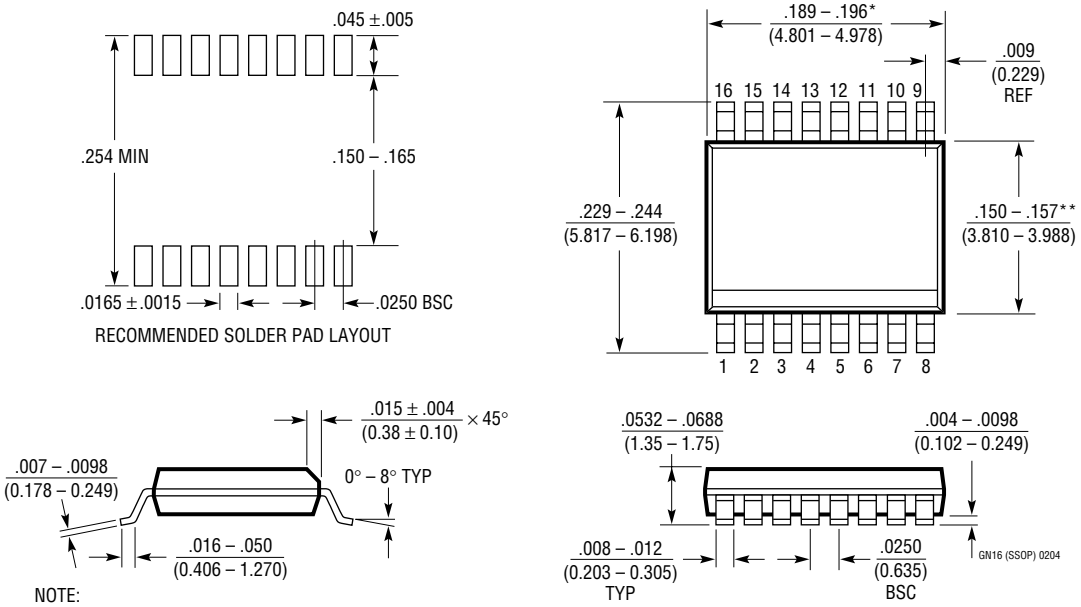


BOTTOM VIEW—EXPOSED PAD

NOTE:
1. DRAWING PROPOSED TO BE MADE VARIATION OF VERSION (WJED-1) IN JEDEC PACKAGE OUTLINE MO-229
2. DRAWING NOT TO SCALE
3. ALL DIMENSIONS ARE IN MILLIMETERS
4. DIMENSIONS OF EXPOSED PAD ON BOTTOM OF PACKAGE DO NOT INCLUDE MOLD FLASH. MOLD FLASH, IF PRESENT, SHALL NOT EXCEED 0.15mm ON ANY SIDE
5. EXPOSED PAD SHALL BE SOLDER PLATED
6. SHADED AREA IS ONLY A REFERENCE FOR PIN 1 LOCATION ON THE TOP AND BOTTOM OF PACKAGE

PACKAGE DESCRIPTION

GN Package
16-Lead Plastic SSOP (Narrow .150 Inch)
(Reference LTC DWG # 05-08-1641)



NOTE:
1. CONTROLLING DIMENSION: INCHES
2. DIMENSIONS ARE IN $\frac{\text{INCHES}}{(\text{MILLIMETERS})}$
3. DRAWING NOT TO SCALE

*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

**DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

REVISION HISTORY (Revision history begins at Rev E)

REV	DATE	DESCRIPTION	PAGE NUMBER
E	5/10	Replaced Product Selection Guide	1
		Labeled packages with appropriate part numbers in Pin Configuration section	2
		Changed title of Table 1 in Mode Control section	8
		Updated Feature Summary section	9
		Revised first sentence of Power Saving Modes section	10

LINEAR TECHNOLOGY

Information furnished by Linear Technology Corporation is believed to be accurate and reliable. However, no responsibility is assumed for its use. Linear Technology Corporation makes no representation that the interconnection of its circuits as described herein will not infringe on existing patent rights.

TYPICAL APPLICATION

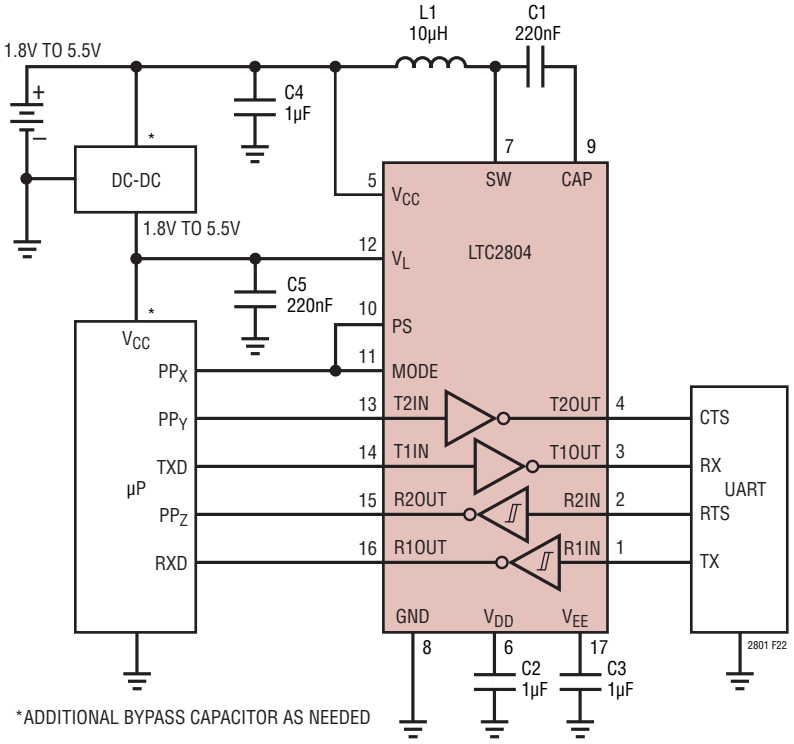


Figure 22. Diagnostic Port Operating Directly Off Unregulated Battery Voltage

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1780/LT1781	2-Driver/2-Receiver RS232 Transceiver	Single 5V Supply with 0.1µF Capacitors, 15kV ESD
LTC1337	3-Driver/5-Receiver RS232 Transceiver	Ultralow Power for DTE Applications
LTC1338	5-Driver/3-Receiver RS232 Transceiver	Ultralow Power for DCE Applications
LT1039/LT1039-16	3-Driver/3-Receiver RS232 Transceiver	30kΩ Input Impedance for Multidrop Applications
LTC1348	3-Driver/5-Receiver RS232 Transceiver	True RS232 Levels on 3.3V Supply

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