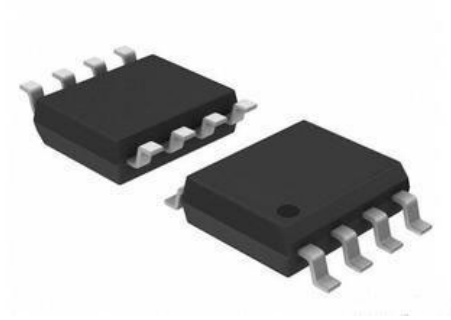
MORNSUN®

SCM3401A Half-duplex Transceiver

Features

- 5.0V single supply operation
- Baud Rate Up to 1Mbps
- 1/8 Unit Load—Up to 256 Nodes on a Bus
- Low Quiescent Power
  - 0.3mA Active Mode
  - 50nA Shutdown Mode
- Bus-Pin ESD Protection Up to 15 kV
- Driver short circuit protection

Package



Mechanical package: SOP-8
(see “Ordering information” for details).

Applications

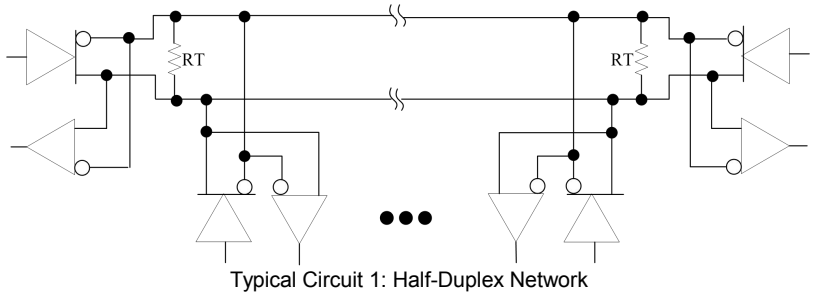
- Industrial Automation
- Building Automation
- Smart Electricity Meter
- Remote Signal Interaction, Transmission

Functional Description

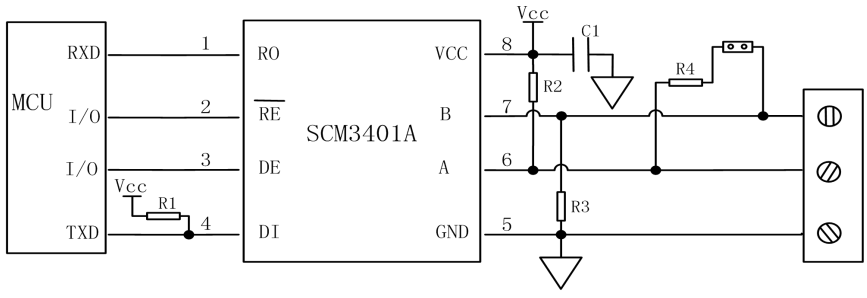
SCM3401A is a half-duplex enhanced transceiver designed for RS–485 data bus networks. Powered by 5V supply, the SCM3401A is fully compliant with TIA/EIA-485A standard and is suitable for data transmission of up to 1 Mbps. Receivers have an exceptionally high input impedance, which places only 1/8 of the standard load on a shared bus and up to 256 transceivers .

The reliability design of A B pin is emphasized, including driver output over current protection and enhanced ESD design. The ESD protection level of A,B pin can be up to 15KV (Human Body Model).

Typical Application Circuit



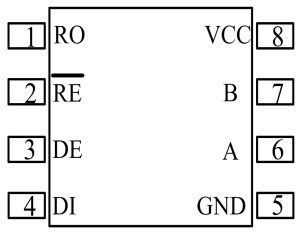
Typical Circuit 1: Half-Duplex Network



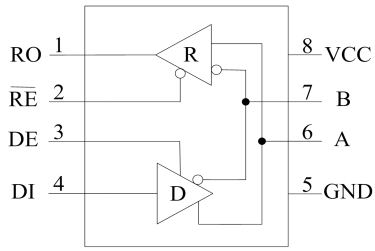
Typical Circuit: 2:Application Diagram

Contents

Pin Connection



Internal Block Diagram



Function table

Driver				
Input			Outputs	
$\overline{RE}$	DE	DI	A	B
X	H	H	H	L
X	H	L	L	H
L	L	X	Z	Z
H	L	X	Z (SHUTDOWN)	

Receiver			
Input			Output
$\overline{RE}$	DE	A-B	RO
L	X	≥-10mV	H
L	X	≤-200mV	L
L	X	Open/Short	H
H	H	X	Z
H	L	X	Z (SHUTDOWN)

Pin descriptions

Pin Number	Pin Name	Pin Functions
1	RO	Receiver Output. When $\overline{RE}$ is low and if (A – B) ≥ -10mV, RO is high. If (A – B) ≤ - 200mV, RO is low.
2	$\overline{RE}$	Receiver Output Enable. When $\overline{RE}$ is low, RO is enabled. When $\overline{RE}$ is high, RO is high impedance. Drive $\overline{RE}$ high and DE low to enter shutdown mode.
3	DE	Driver Output Enable. When DE is high, outputs are enabled. When DE is low, outputs are high impedance. Drive DE low and $\overline{RE}$ high to enter shutdown mode.
4	DI	Driver Input.
5	GND	Ground
6	A	Non-Inverting Driver Output / Receiver input
7	B	Inverting Driver Output / Receiver input
8	VCC	Positive Supply VCC. Bypass to GND with a 0.1uF capacitor.

Absolute Maximum Ratings

General test conditions: Free-air, normal operating temperature range (unless otherwise specified).

PARAMETERS	UNIT
Supply voltage range, Vcc	-0.3V~+6V
Voltage range at A or B	-8V~+13V
Voltage range at DE、DI、$\overline{RE}$、RO	-0.3V~+6V
Storage Temperature	-55℃~150℃
Lead Temperature (soldering, 10s)	300℃

Important: Exposure to Absolute Maximum Rated conditions for an extended period may severely affect the device reliability, and stress levels exceeding the “Absolute Maximum Ratings” may result in permanent damage.

Recommended Operating Conditions

Recommended Operating Conditions		Min.	Nom.	Max.	Unit
Supply Voltage, V_{VCC}		4.5	5	5.5	V
Voltage at any bus terminal (differential or common mode), V_I		-7		12	
High-level input voltage (DI, DE, $\overline{RE}$) , V_{IH}		2		VCC	
Low-level input voltage (DI, DE, $\overline{RE}$) , V_{IL}		0		0.8	
Output current	Driver	-60		60	mA
	Receiver	-8		8	
Differential load resistance		54	60		Ω
Signaling rate				1000	Kbps
Operating ambient temperature, T_A in free–air		-40		85	℃
Operating junction temperature, T_J		-40		125	℃

Electrical Characteristics

General test conditions and V_{VCC}= 5V, Ta = 25℃ (unless otherwise specified).

PARAMETERS		CONDITIONS		Min.	Nom.	Max.	Unit
Digital Input Signals: DI, DE, $\overline{RE}$							
Logic input thresholds		High, V_{IH}		2			V
		Low, V_{IL}				0.8	
Driver							
Differential Driver Output (V_{OD})		No Load				V_{VCC}	V
Differential Driver Output (1)		RL=54Ω, Figure 16		1.5	2.0		V
Differential Driver Output (2)		V_{CM} = -7 ~ 12V, Figure 17		1.5		V_{VCC}	
Driver Common Mode Output Voltage		Figure18		1		3	V
Change in Common Mode Output Voltage		Figure19				±0.2	V
Driver Short Circuit Current Limit		-7V≤V_{OUT}≤12V , Figure22			±110	±250	mA
Receiver							
Receiver Input Resistance		-7V≤V_{OUT}≤12V		96			KΩ
Input Current (A, B pins)		DE=0 , $\overline{RE}$ =0, V_{VCC}=0 or 5.5V	V_{OUT} =12V		190	250	uA
			V_{OUT} = -7V		-110	-200	uA
Change in magnitude of differential output voltage		I_O = ±8 mA		-200		-10	mV
Receiver Input Hysteresis					30		mV
Receiver Output Voltage	V_{OH}, Figure 23	I_{OUT} = -5mA , V_{ID}= 200mV		V_{VCC}-1.5			V
	V_{OL}, Figure 24	I_{OUT} = 5mA , V_{ID}= -200mV				0.4	
Supply and Protection							
I_{VCC}	Driver and receiver enabled	DE = V_{VCC} , $\overline{RE}$ = 0 , No load			250	900	uA
	Driver enabled, receiver disabled	DE = V_{VCC} , $\overline{RE}$ = V_{VCC} , No load			250	900	uA
	Receiver enabled, driver disabled	DE = V_{VCC} , $\overline{RE}$ = 0 , No load			220	600	uA
	Driver and receiver disabled	DE = 0 , $\overline{RE}$ = V_{VCC} , No load			0.05	1	uA
ESD	Human Body Model	A, B and GND			±15		KV
		Other pins			±4		KV
EFT	IEC61000-4-4	A, B and GND			±1		KV

Transmission Characteristics

General test conditions and V_{CC} = 5V, Ta = 25℃ (unless otherwise specified).

PARAMETERS	CONDITIONS	Min.	Nom.	Max.	Unit
Driver					
Data Signaling Rate	Duty Cycle 40% ~ 60%			1000	Kbps
Driver Propagation Delay (T_{PHL} , T_{PLH})	R_L = 54Ω,C_L = 50pF, Figure 19			100	ns
Driver Output Rise/Fall Time (T_R , T_F)				100	ns
Driver Differential Skew ($\|T_{PHL} - T_{PLH}\|$)		-50		50	ns
Driver Enable to Output High (T_{PZH})	R_L=110Ω, $\overline{RE}$ = 0,Figure 20, Figure 21		100	500	ns
Driver Enable to Output Low (T_{PZL})			100	500	ns
Driver Disable from Output High (T_{PHZ})			50	100	ns
Driver Disable from Output Low (T_{PLZ})			50	100	ns
Shutdown to Driver Output Valid ($T_{PZH(SHDN)}$, $T_{PZL(SHDN)}$)	R_L=110Ω, $\overline{RE}$ =V_{CC}, Figure 20		50	100	ns
Receiver					
Receiver Propagation Delay (T_{PLH} , T_{PHL})	C_L = 15pF, Figure 22		50	100	ns
Receiver Differential Skew ($\|T_{PLH} - T_{PHL}\|$)		-50		50	ns
Receiver Output Rise/Fall Time (T_R , T_F)	C_L = 15pF, V_{DI}=-1.5V~1.5V, Figure 22			15	ns
Receiver Enable to Output High (T_{PZH})	C_L = 15pF, Figure 23, Figure 24		20	50	ns
Receiver Enable to Output Low (T_{PZL})			20	50	ns
Receiver Disable from Output High (T_{PHZ})			20	50	ns
Receiver Disable from Output Low (T_{PLZ})			30	50	ns
Shutdown to Receiver Output Valid ($T_{PZH(SHDN)}$,$T_{PZL(SHDN)}$)	C_L = 15pF, DE = 0V, Figure 25		500	1000	ns
Time to Shutdown		50		600	ns

Typical Performance Curves

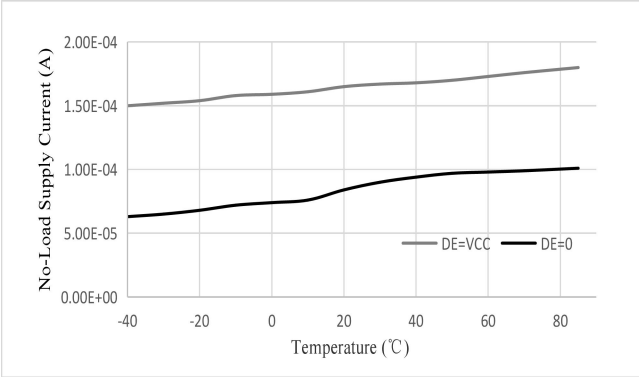


Figure 1 No-Load Supply Current vs. Temperature

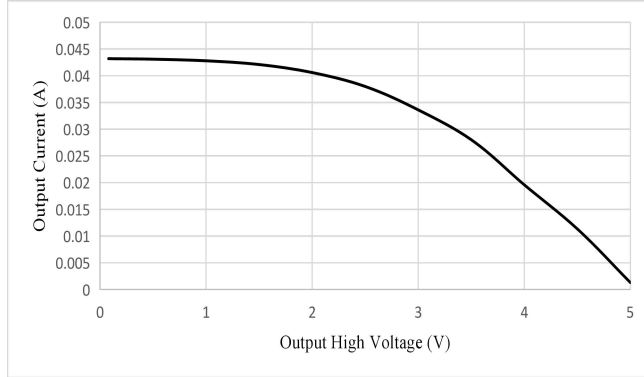


Figure 2 Output Current vs. Receiver Output High Voltage

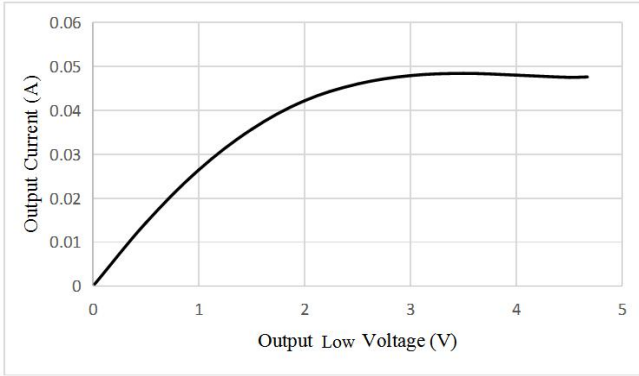


Figure 3 Output Current vs. Receiver Output Low Voltage

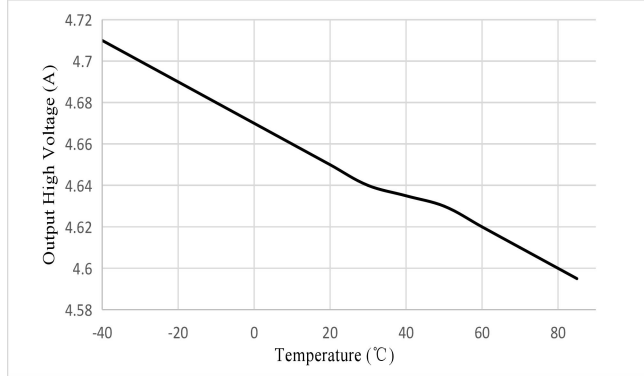


Figure 4 Receiver Output High Voltage vs. Temperature

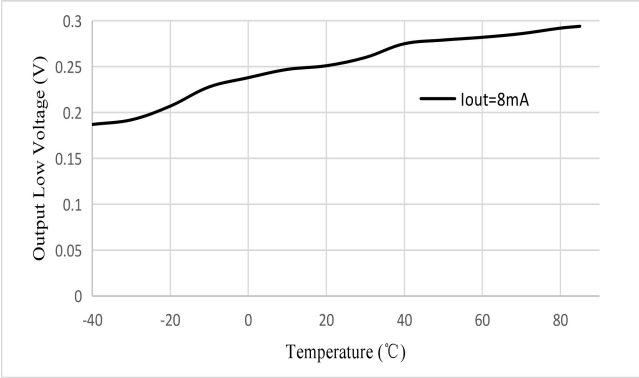


Figure 5 Receiver output low voltage vs. Temperature

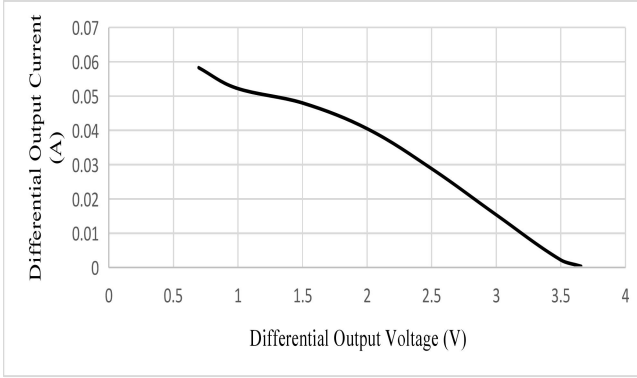


Figure 6 Driver differential output current vs. Differential output voltage

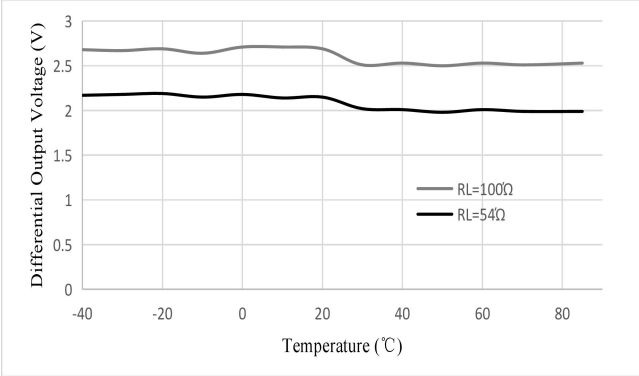


Figure 7 Driver Differential Output Voltage vs Temperature

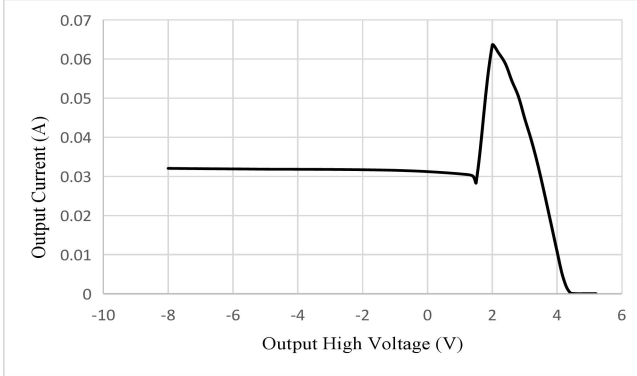


Figure 8 Output current vs. Transmitter output high voltage

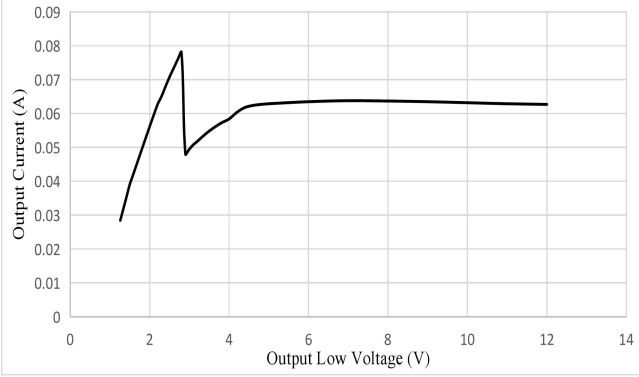


Figure 9 Output current vs. Transmitter output low voltage

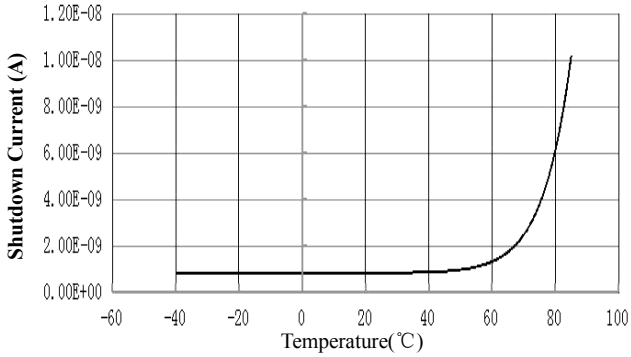


Figure 10 Shutdown Current vs. Temperature

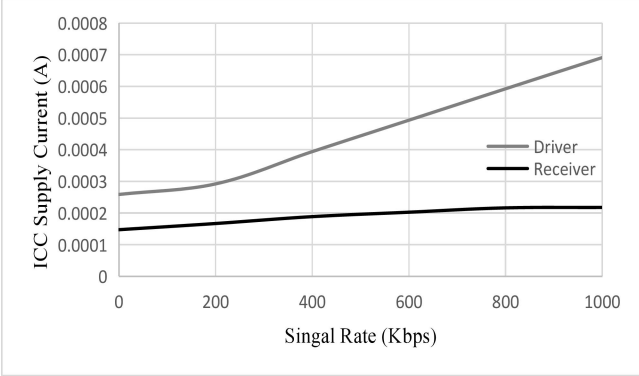


Figure 11 RMS Supply Current vs. Signaling Rate

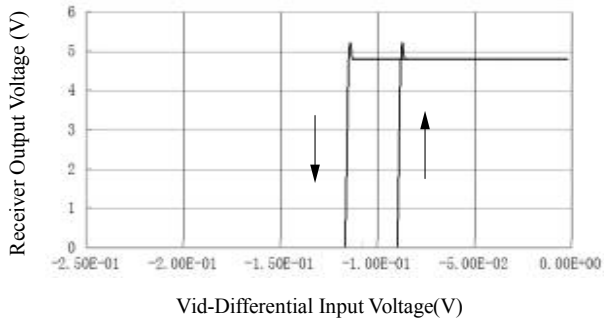


Figure 12 Receiver output voltage vs. Differential input voltage

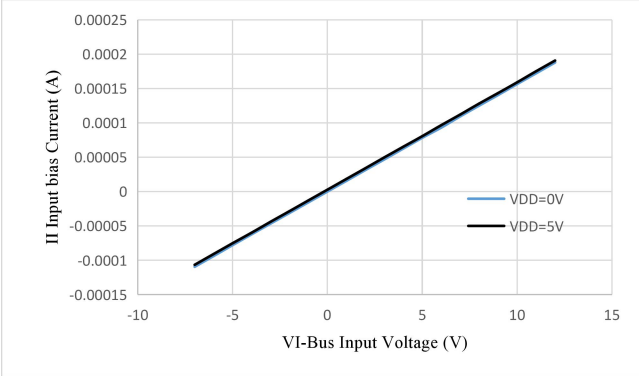


Figure 13 Bus input current vs. Bus input voltage

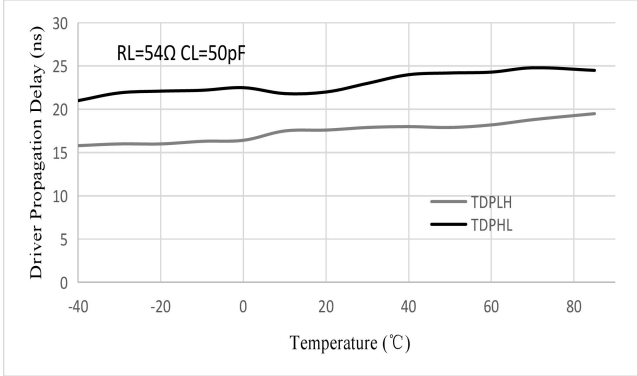


Figure 14 Driver propagation delay vs. Temperature

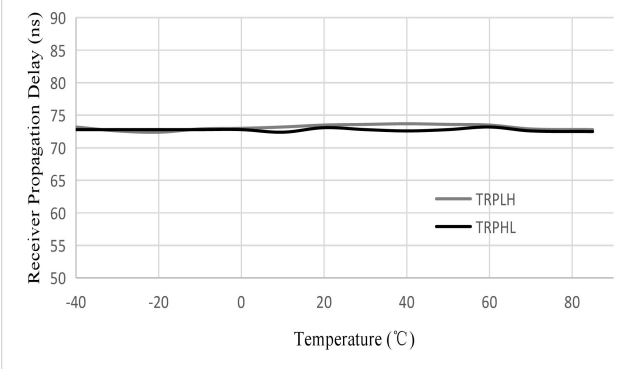


Figure 15 Receiver Propagation Delay vs. Temperature

Test Circuits

NOTE: Load test capacitance includes probe and test fixture stray capacitance, unless otherwise specified. Signal generator with following characteristics: Rise and fall time < 6ns, pulse rate 100kHz, 50% duty cycle, ZO = 50Ω (unless otherwise specified).

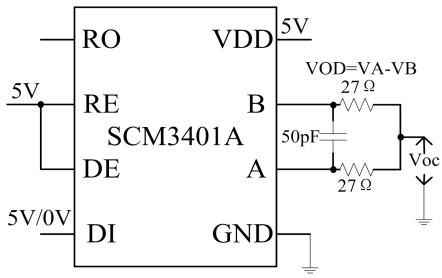


Figure 16 Driver Test Circuit, V_{OD} and V_{OC} Without Common-Mode Loading

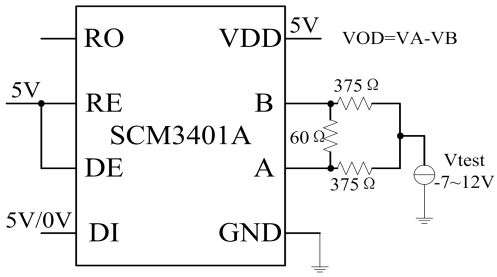


Figure 17 Driver Test Circuit, V_{OD} With Common-Mode Loading

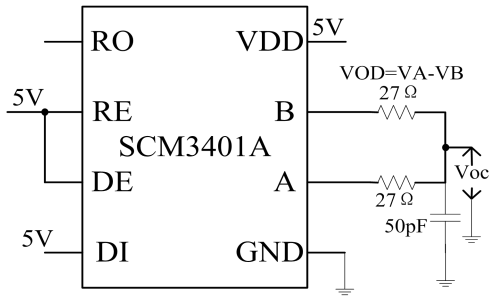


Figure 18 Driver V_{OC} Test Circuit

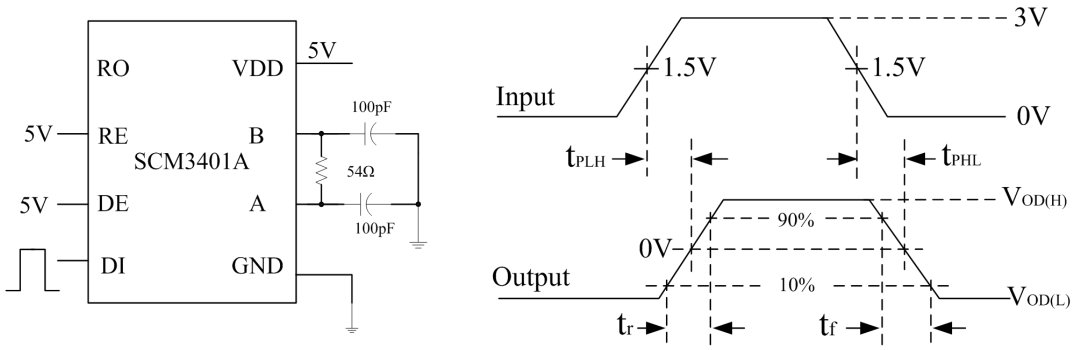


Figure 19 Driver Switching Test Circuit and Waveforms

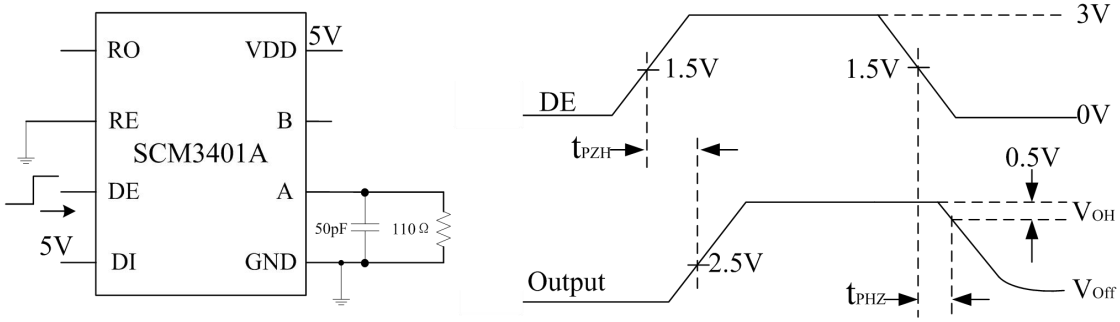


Figure 20 Driver Enable/Disable Test Circuit and Waveforms, High Output

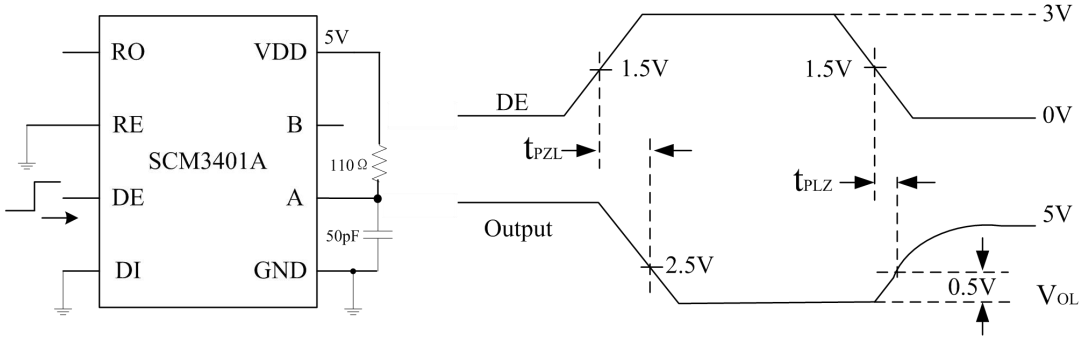


Figure 21 Driver Enable/Disable Test Circuit and Waveforms, Low Output

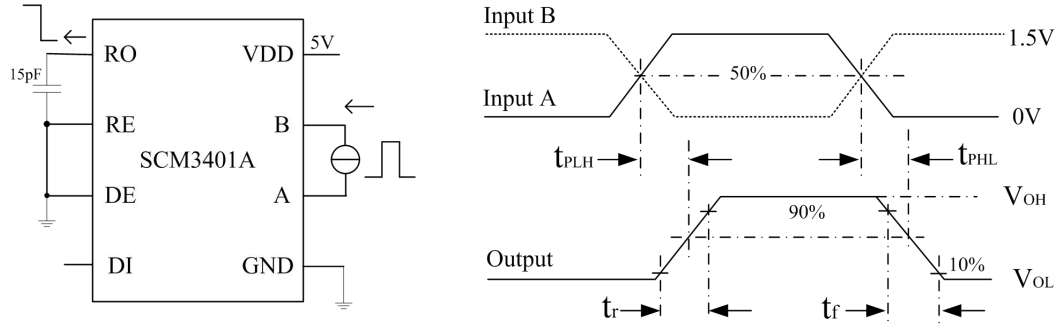


Figure 22 Receiver Switching Test Circuit and Waveforms

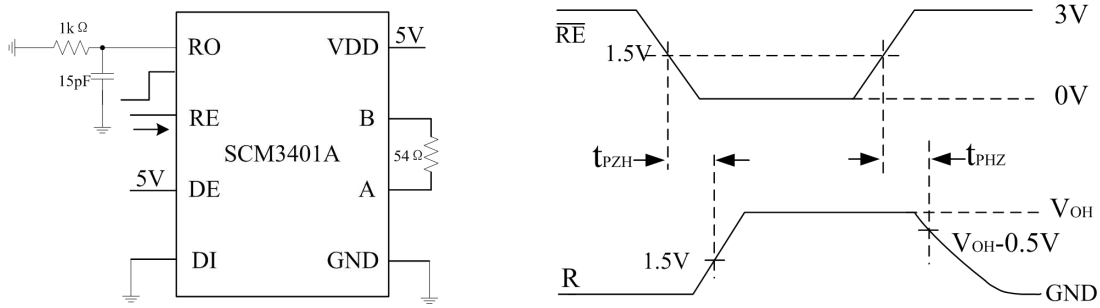


Figure 23 Receiver Enable/Disable Test Circuit and Waveforms, Data Output High

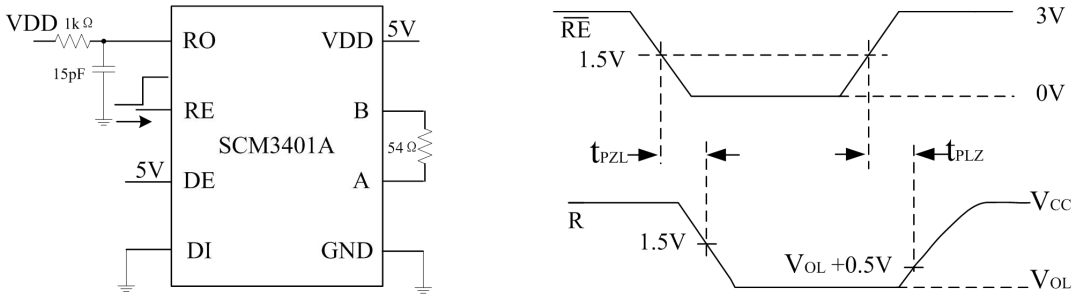


Figure 24 Receiver Enable/Disable Test Circuit and Waveforms, Data Output Low

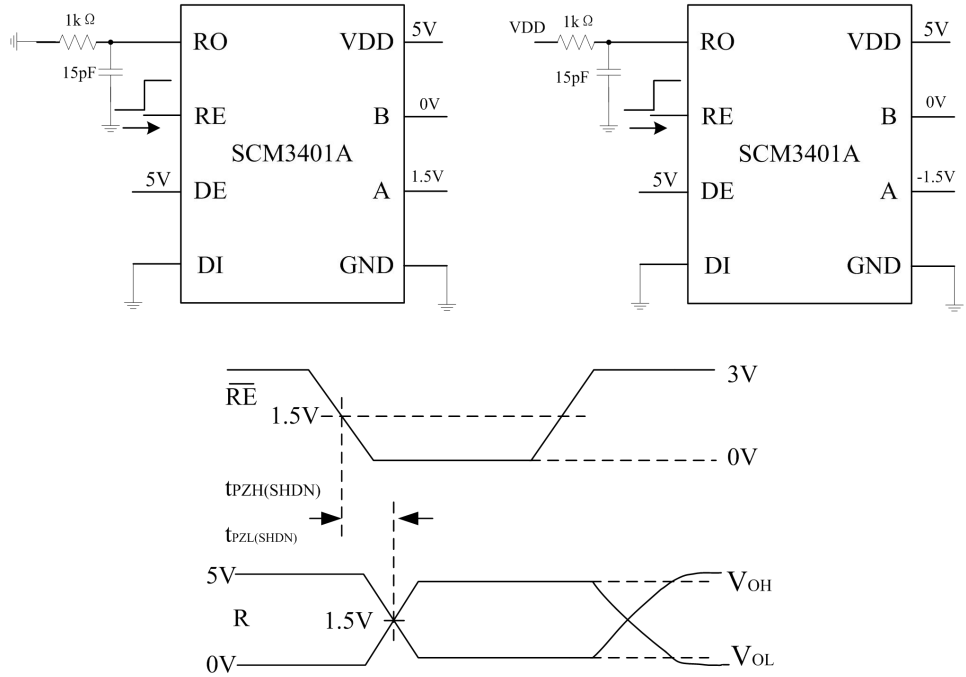


Figure 25 Receiver Enable from Shutdown Test Circuit and Waveforms

Detailed Description

The SCM3401A series are advanced RS-485 transceivers. They each contain one driver and one receiver. These devices feature a fail-safe circuitry that guarantees a high receiver output voltage when the receiver inputs are either open, shorted or when they are connected to a terminated transmission line with all drivers disabled. These devices operate with a single 5.0V supply. Drivers limit the output current by over current protection, to avoid the damage to the transceivers.

Receiver input filter

The SCM3401A receivers have an integrated input filter which enhances noise immunity of the high-speed differential signals. The receiver propagation delay increases due to this filtering.

Bus fail-safe

Ordinary RS485 bus receivers will be in an indeterminate state when -200mV< A - B <-10mV. This situation can occur whenever the data bus is not being actively driven. The advanced Fail-safe feature of the SCM3401A guarantees a high receiver output voltage if the receiver's differential inputs are either shorted, open circuit, or if they are connected to a termination resistor.

The SCM3401A receiver thresholds are very precise, and the offset between threshold voltage and ground has a margin of at least 10mV. This guarantees that the receiver output is a high voltage even the input differential is zero volts, thus maintaining compliance with the EIA/TIA-485 standard .

Load abilities on the bus (256 nodes)

The standard receiver input impedance of RS-485 is 12kΩ (1 unit load). A standard RS485 driver can drive at least 32 unit loads. The SCM3401A transceiver is design to 1/8th of the standard unit load and the input impedance is higher than 96kΩ, hence allowing up to 256 unit loads, in other words eight times as many. The SCM3401A can work combined with other standard RS485 that use the smaller amount of unit loads.

Low power shunt down mode

A low-power shutdown mode is triggered by simultaneously bringing $\overline{RE}$ high and DE low. During shutdown mode the device supply current is 50nA typical. DE and $\overline{RE}$ can be directly connected and controlled by the same I/O. The devices are guaranteed not to enter shutdown mode if $\overline{RE}$ is high and DE is low for less than 50ns. If this state is maintain for at least 600ns, the device will shut down reliably.

Driver output protection

The device prevents excessive output current caused by fault conditions or driver short circuit. A driver current limit on the output stage provides and ensures immediate protection against short circuits over the entire common mode voltage range.

Expansion Output Design

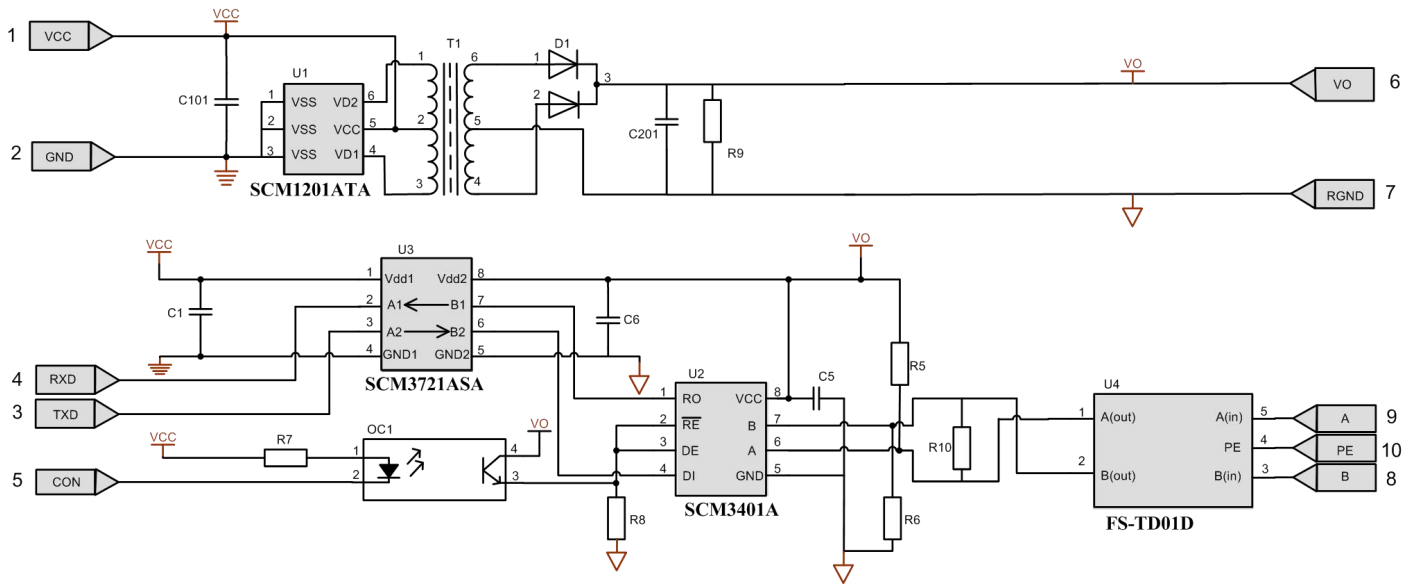


Fig. 26 Schematic diagram of isolation application circuit for UART to RS485 signal

Suggestions for Power Supply

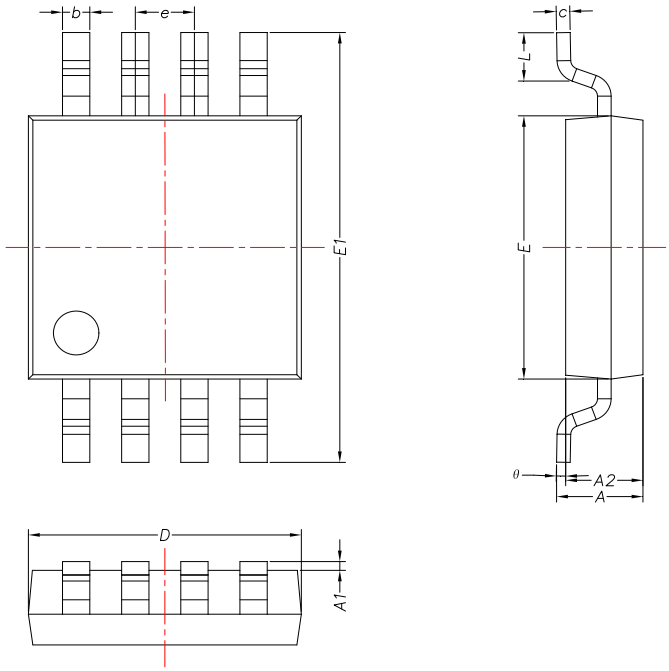
If the input power is a few inches from the SCM3401A, as much as possible, connect a 0.1μF bypass capacitor to the VCC pin and a 10μF capacitor near the center tap pin of the transformer.

Ordering Information

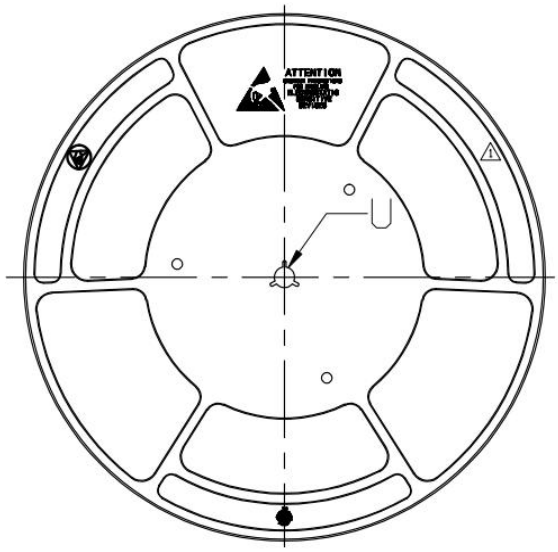
Part number	Package	Number of pins	Product Marking	Tape & Reel
SCM3401ASA	SOP	8	SCM 3401ASA YM	3K/REEL

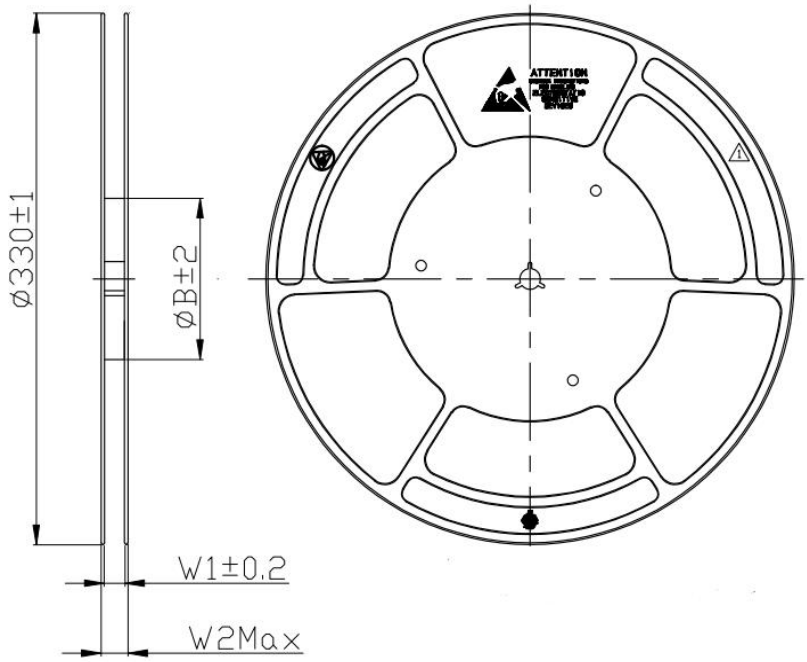
Product marking and date code
SCM3401XYZ:
(1) SCM3401 = Product designation.
(2) X = Version code information (A-Z).
(3) Y = Packaging definition code; S for SOP package,
(4)Z = Operating temperature range (C = 0℃ to +70℃, I =-40℃ to +85℃, A =-40℃ to +125℃, M = -55℃ to +125℃) .
(5) YM = Date code for product traceability; Y = code for production year; M = code for production month.

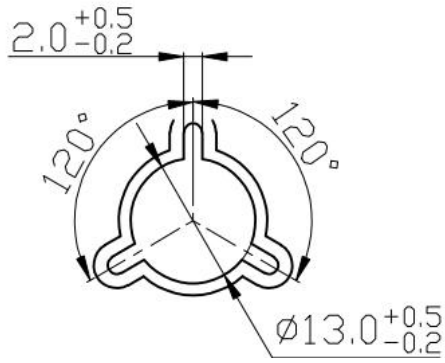
Package Information



Symbol	SOP8			
	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
e	1.270 (BSC)		0.050 (BSC)	
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
L	0.400	1.270	0.016	0.031
θ	0°	8°	0°	8°







U

4 : 1

Basic Disk Dimensions (mm)				
Package Type	Load Band Width	B	W1	W2Max
SOP8	12	180	12.4	18.4

Technical requirement :

1. Color : Blue (Reference color number :
   PANTONE DS 196-1 C ; C100 M70 Y0 K0
   PANTONE DS 197-1 C; C100 M70 Y0 K10
   PANTONE DS 205-1 C; C100 M60 Y0 K20
   PANTONE DS 205-2 C; C85 M50 Y0 K20
   PANTONE DS 206-2 C; C85 M50 Y0 K35
   PANTONE DS 219-1 C; C90 M50 Y5 K15)
2. Dimensions and tolerances according to ANSI/EIA-481-C-2003;
3. Disk surface good finish, no warping deformation ;
4. External packing in good condition, no damage or pollution;

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