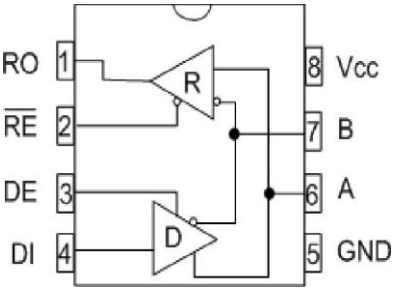
Low Power Half-Duplex RS-485 Transceiver

GENERAL DESCRIPTION

The FC485C is a half-duplex transceiver that meets the specifications of RS-485 and RS-422. Its BiCMOS design allows low power operation without sacrificing performance.
The FC485C meets the requirements of the RS-485 and RS-422 protocols up to 5Mbps underload. The ESD tolerance is more than ±15kV for both Human Body Model and IEC6100-4-2 Air Discharge Method on this device.

PIN CONFIGURATION



FEATURES

- Single +5V supply
- Low Power BiCMOS
- Driver / Receiver Enable for Multi-Drop configurations
- ESD Specifications: +/-15kV Human Body Model

APPLICATIONS

- Low Power RS-485 Systems
- DTE-DCE Interface
- Packet Switching
- Local Area Networks
- Data Concentration
- Data Multiplexers
- Integrated Services Digital Network (ISDN)

PIN FUNCTION

Pin 1 - RO - Receiver Output
Pin 2 - RE - Receiver Output Enable Active LOW
Pin 3 - DE - Driver Output Enable Active HIGH
Pin 4 - DI - Driver Input
Pin 5 - GND - Ground
Pin 6 - A - Driver Output / Receiver Input Non-Inverting
Pin 7 - B - Driver Output / Receiver Input Inverting
Pin 8 - Vcc - Positive Supply (4.75V < Vcc < 5.25V)

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ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

Parameter		Symbol	Ratings
Supply Voltage		V_{CC}	7V
Input Voltage	Logic	V_{IN}	-0.3V to Vcc+0.5V
	Drivers		-0.3V to Vcc+0.5V
	Receivers		+/-15V
Output Voltage	Logic	V_O	-0.3V to Vcc+0.5V
	Drivers		+/-15V
	Receivers		-0.3V to Vcc+0.5V
Power Dissipation 8-pin NSOIC *		P_D	550mW
Power Dissipation 8-pin PDIP **			1000mW
Operating Ambient Temperature Range		T_{OPR}	-40℃ to +85℃
Junction Temperature		T_J	-40℃ to +125℃
Storage Temperature		T_{STG}	-65℃ to +150℃

*-derate 6.60mW/℃ above +70℃

**-derate 11.8mW/℃ above +70℃

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Ratings
Supply Voltage	V_{CC}	5V ±5%
Operating Ambient Temperature Range	T_{OPR}	0℃ to +70℃

ELECTRICAL CHARACTERISTICS

(At specified free-air temperature, V_{CC} = 5V, unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
DRIVER DC Characteristics						
Differential Output Voltage	V_{ODXX}	Unloaded; R = ∞ ; see Figure 1	GND		Vcc	V
Differential Output Voltage	V_{OD50}	With Load; R = 50Ω (RS-422); see Figure 1	2		Vcc	V
Differential Output Voltage	V_{OD27}	With Load; R = 27Ω (RS-485); see Figure 1	1.5		Vcc	V
Change in Magnitude of Driver Differential Output Voltage for Complimentary states	ΔV_{OD}	R = 27Ω or R = 50Ω; see Figure 1			0.2	V
Driver Common Mode Output Voltage	V_{oc}	R = 27Ω or R = 50Ω; see Figure 1			3	V
Input High Voltage	V_{INH}	Applies to DE, DI, $\overline{RE}$	2.0			V
Input Low Voltage	V_{INL}	Applies to DE, DI, $\overline{RE}$			0.8	V
Input Current	I_{IC}	Applies to DE, DI, $\overline{RE}$			+/-10	μA
Driver Short Circuit Current						
V_{OUT} =HIGH	I_{SCH}	-7V<V_O<+12V			+/-250	mA
V_{OUT}=LOW	I_{SCL}	-7V<V_O<+12V			+/-250	mA
DRIVER AC Characteristics						
Max. Transmission Rate	TRD	$\overline{RE}$ = 5V, DE = 5V; R_{DIFF} = 54Ω, C_{L1}=C_{L2}=100pF	5			Mbps
Driver Input to Output	t_{DPLH}	See Figures 3 & 5, R_{DIFF} = 54Ω, C_{L1}=C_{L2}=100pF		30	60	ns
Driver Input to Output	t_{DPHL}	See Figures 3 & 5, R_{DIFF} = 54Ω, C_{L1}=C_{L2}=100pF		30	60	ns
Driver Skew	t_{SKEW}	See Figures 3 and 5, t_{SKEW} = |t_{DPHL} - t_{DPLH}|		5	10	ns

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Driver Rise or Fall Time	t_{ZL}, t_{ZH}	From 10%-90%; R_{DIFF} = 54Ω, C_{L1}=C_{L2}=100pF; see Figures 3 and 6		15	40	ns
Driver Enable to Output High	t_{EH}	C_L =100pF, see Figures 4 and 6, S_2 closed		40	70	ns
Driver Enable to Output Low	t_{EL}	C_L =100pF, see Figures 4 and 6, S_1 closed		40	70	ns
Driver Disable Time from High	t_{DH}	C_L =100pF, see Figures 4 and 6, S_2 closed		40	70	ns
Driver Disable Time from Low	t_{DL}	C_L =100pF, see Figures 4 and 6, S_1 closed		40	70	ns
RECEIVER DC Characteristics						
Differential Input Threshold	V_{TH}	-7V ≤ V_{CM} ≤ +12V	-0.2		+0.2	V
Input Hysteresis	V_{HYS}	V_{CM} = 0V		20		mV
Output Voltage High	V_{OH}	I_O = -4mA, V_{ID} = +200mV	3.5			V
Output Voltage Low	V_{OL}	I_O = +4mA, V_{ID} = +200mV			0.4	V
Three-State (High Impedance) Output Current	I_{TS}	0.4V ≤ V_O ≤ 2.4V; $\overline{RE}$ = 5V			+/-1	μA
Input Resistance	R_{IN}	-7V ≤ V_{CM} ≤ +12V	12	15		κΩ
Input Current (A, B); V_{IN} = 12V	I_{IN12}	DE = 0V, V_{CC} = 0V or 5.25V, V_{IN} = 12V			+1.0	mA
Input Current (A, B); V_{IN} = -7V	I_{IN7}	DE = 0V, V_{CC} = 0V or 5.25V, V_{IN} = -7V			-0.8	mA
Short Circuit Current	I_{SC}	0V ≤ V_O ≤ V_{CC}	7		95	mA
RECEIVER AC Characteristics						
Max. Transmission Rate	TRR	$\overline{RE}$ = 0V, DE = 0V	5			Mbps
Receiver Input to Output	t_{PLH}	See Figures 3 and 7, R_{DIFF} = 54Ω, C_{L1}=C_{L2}=100pF	20	45	100	ns
Receiver Input to Output	t_{PHL}	See Figures 3 and 7, R_{DIFF}= 54Ω, C_{L1}=C_{L2}=100pF	20	45	100	ns
Differential Receiver Skew	t_{SKEWR}	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF, see Figures 3 and 7 t_{SKEWR} = $\lvert t_{PHL} - t_{PLH} \rvert$		13		ns
Receiver Enable to Output Low	t_{EOL}	C_{RL} = 15pF, Figures 2 and 8; S_1 Closed		45	70	ns
Receiver Enable to Output High	t_{EOH}	C_{RL} = 15pF, Figures 2 and 8; S_2 Closed		45	70	ns
Receiver Disable from LOW	t_{DL}	C_{RL} = 15pF, Figures 2 and 8; S_1 Closed		45	70	ns
Receiver Disable from High	t_{DH}	C_{RL} = 15pF, Figures 2 and 8; S_2 Closed		45	70	ns
SUPPLY Current						
No load		$\overline{RE}$, DI=0V or V_{CC}; DE=V_{CC}		900		μA
		$\overline{RE}$=0V; DI=0V or 5V; DE=0V		600		μA

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TEST CIRCUITS

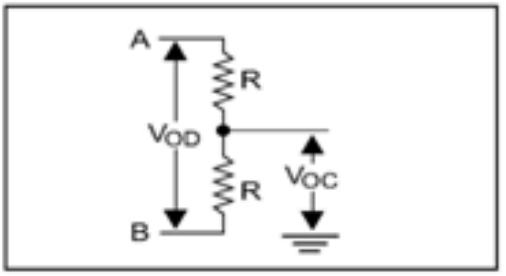


Figure 1. RS-485 Driver DC Test Load Circuit

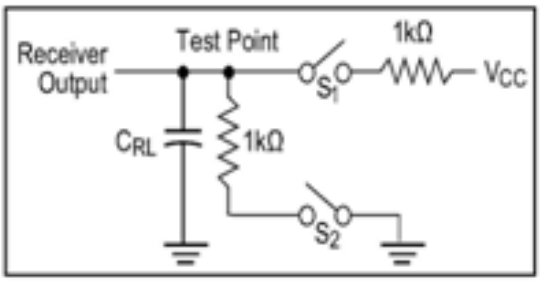


Figure 2. Receiver Timing Test Load Circuit

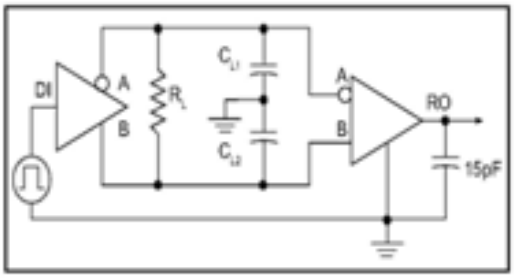


Figure 3. RS-485 Driver/Receiver Timing Test

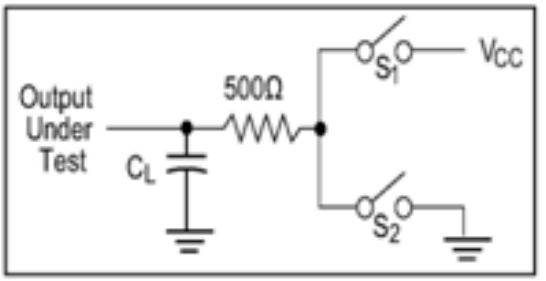
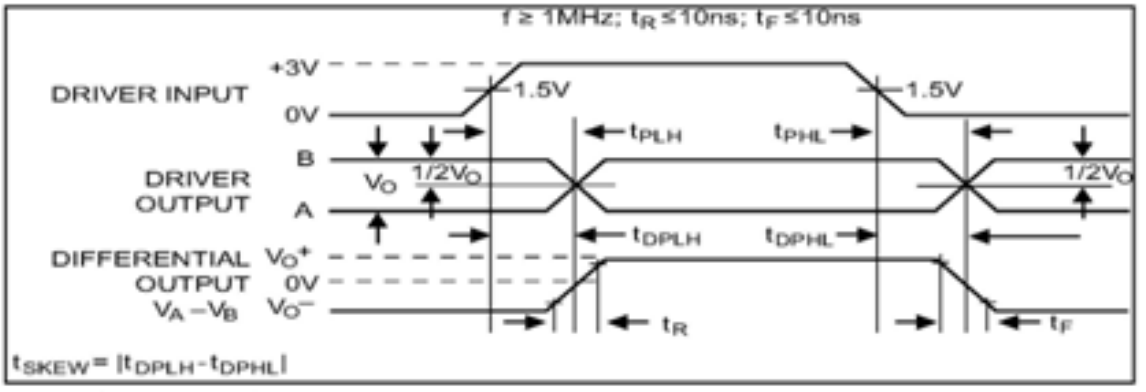


Figure 4. Driver Timing Test Load #2 Circuit



Driver Propagation Delays

FUNCTION TRUTH TABLES

INPUTS				OUTPUTS	
$\overline{RE}$	DE	DI	LINE CONDITION	A	B
X	1	1	No Fault	1	0
X	1	0	No Fault	0	1
X	0	X	X	z	z
X	1	X	Fault	z	z

Table 1. Transmit Function Truth Table

INPUTS			OUTPUTS
$\overline{RE}$	DE	A-B	RO
0	0	+0.2V	1
0	0	-0.2V	0
0	0	Inputs Open	1
1	0	X	z

Table 2. Receive Function Truth Table

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SWITCHING WAVEFORMS

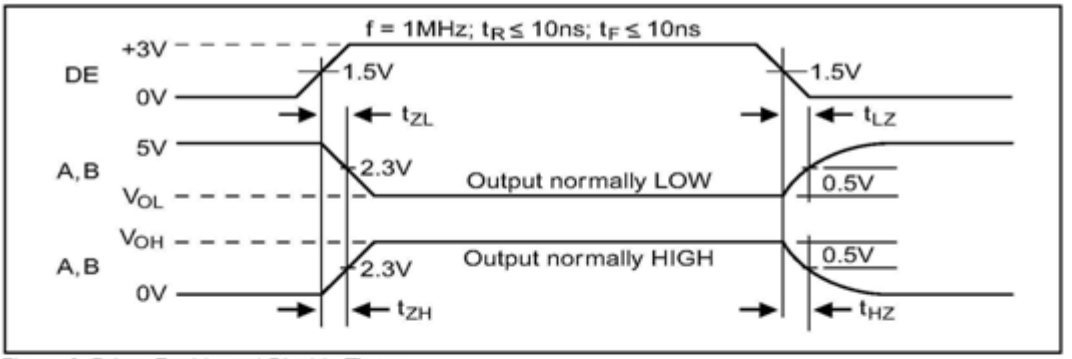


Figure 6. Driver Enable and Disable Times

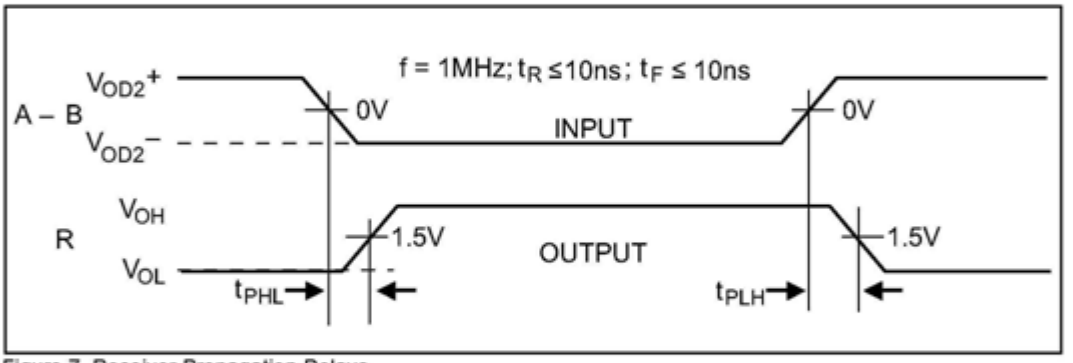
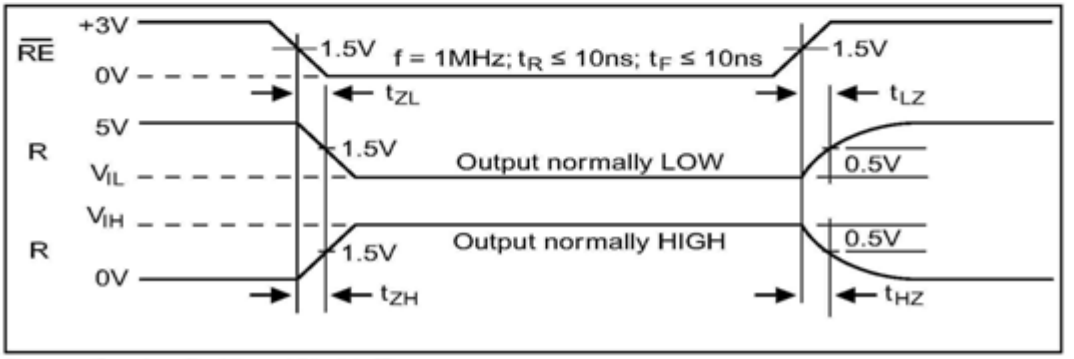


Figure 7. Receiver Propagation Delays



Receiver Enable and Disable Times

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FUNCTIONAL DESCRIPTION

The FC485C is half-duplex differential transceiver that meets the requirements of RS-485 and RS-422. The RS-485 standard is ideal for multi-drop applications and for long-distance interfaces. RS-485 allows up to 32 drivers and 32 receivers to be connected to a data bus, making it an ideal choice for multi-drop applications. Since the cabling can be as long as 4,000 feet, RS-485 transceivers are equipped with a wide (-7V to +12V) common mode range to accommodate ground potential differ- ences. Because RS-485 is a differential interface, data is virtually immune to noise in the transmission line.

DRIVERS

The driver outputs of the FC485C are differential outputs meeting the RS-485 and RS-422 standards. The typical voltage output swing with no load will be 0 Volts to +5 Volts. With worst case loading of 54Ω across the differential outputs, the drivers can maintain greater than 1.5V voltage levels. The drivers of the FC485C have an enable control line which is active HIGH. A logic HIGH on DE (pin 3) will enable the differential driver outputs. A logic LOW on the DE (pin 3) will tri-state the driver outputs.

The transmitters of the FC485C will operate up to at least 5Mbps.

RECEIVERS

The FC485C receiver has differential inputs with an input sensitivity as low as ±200mV. Input impedance of the receivers is typically 15kΩ (12kΩ minimum). A wide common mode range of -7V to +12V allows for large ground potential differences between systems. The receivers of the FC485C have a tri-state enable control pin. A logic LOW on RE (pin 2) will enable the receiver, a logic HIGH on RE (pin 2) will disable the receiver.

The receiver for the FC485C will operate up to at least 5Mbps. The receiver is equipped with the fail-safe feature. Fail-safe guarantees that the receiver output will be in a HIGH state when the input is left unconnected.

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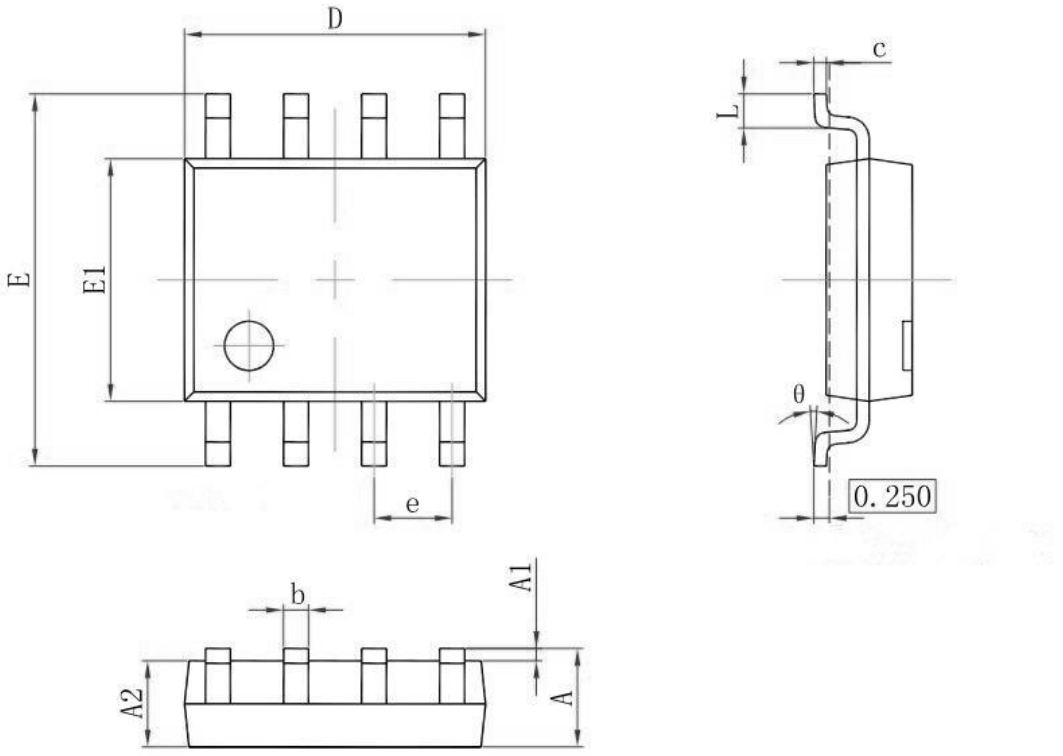
SOP8 Package Information



Symbol	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	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.031
θ	0°	8°	0°	8°