

General Description

The KY3485 3.3/5V, half-duplex, $\pm 20\text{kV}$ ESD-protected RS-485/RS-422 compatible transceivers feature one driver and one receiver.

The KY3485 features enhanced slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free transmission up to 500kbps.

The KY3485 feature a 1/8-unit load receiver input impedance, allowing up to 256 transceivers on the bus. These devices are intended for half-duplex communications. All driver outputs are protected to $\pm 20\text{kV}$ ESD using the Human Body Model and $\pm 8\text{kV}$ ESD using the Contact Discharge Method.

The KY3485 is available in an 8-pin SO package. The devices operate over the extended -40°C to $+125^\circ\text{C}$ temperature range.

Absolute Maximum Ratings (All voltages referenced to GND.)

Supply Voltage VCC.....	+6V
DE, RE-, DI.....	-0.3V to +6V
A, B.....	-8V to +13V
Short-Circuit Duration (RO, A, B) to GND	Continuous
Continuous Power Dissipation (TA = +70°C)	
8-Pin SO (derate 5.9mW/°C above +70°C).....	471mW
Operating Temperature Range	-40°C to $+125^\circ\text{C}$
Junction Temperature.....	$+150^\circ\text{C}$
Storage Temperature Range	-65°C to $+150^\circ\text{C}$
Lead Temperature (soldering 10s)	$+300^\circ\text{C}$

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

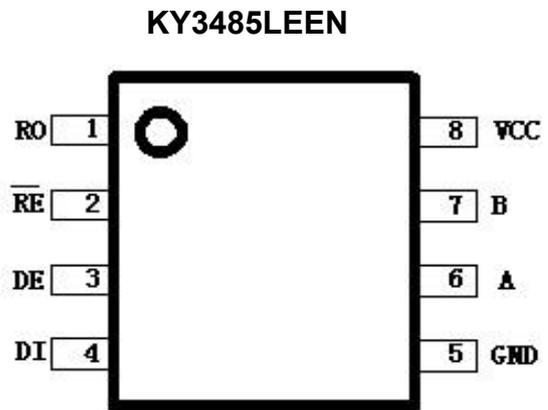
Features

- 3.3/5V Operation
- Hot-Swappable for Telecom Applications
- Enhanced Slew-Rate Limiting Facilitates Error-Free Data Transmission
- Extended ESD Protection for RS-485 I/O Pins $\pm 20\text{kV}$ HBM
- 1/8Unit Load , Allowing Up to 256 Transceivers on the Bus
- 8 Pin-SO Package

Applications

- Isolated RS-485 Interfaces
- Utility Meters
- Industrial Controls
- Industrial Motor Drives
- Automated HVAC Systems

Package Information



Package: SOIC8

DC Electrical Characteristics

(VCC = +3.3V ± 5%, TA = TMIN to TMAX, unless otherwise noted. Typical values are at TA = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DRIVER						
Differential Driver Output (no load)	V _{OD1}	Figure1		3.3		V
Differential Driver Output	V _{OD2}	Figure1,R = 50Ω (RS-422)	1.8			V
		Figure1,R = 27Ω (RS-485)	1.2			
Change in Magnitude of Differential Output Voltage (Note 2)	ΔV _{OD}	Figure1,R =50Ωor R= 27Ω			0.2	V
Driver Common-Mode Output Voltage	V _{OC}	Figure1,R=50Ωor R = 27Ω			2	V
Change In Magnitude of Common-Mode Voltage (Note 2)	ΔV _{OC}	Figure1,R=50SΩor R = 27Ω			0.2	V
Input High Voltage	V _{IH1}	DE , DI ,RE-	2.0			V
Input Low Voltage	V _{IL1}	DE, DI, RE-,			0.8	V
DI Input Hysteresis	V _{HYS}	KY3485		100		mV
Input Current	I _{IN1}	DE, DI, RE-,			±2	μA
Input Current (A and B)	I _{IN4}	DE = GND, VCC=3.3V	V _{IN} =12V		125	μA
			V _{IN} = -7V	-75		
Driver Short-Circuit Output Current (Note 3)	I _{OD1}	-7V ≤ V _{OUT} ≤ V _{CC}	-250			mA
		0V ≤ V _{OUT} ≤ 12V			250	mA
		0V ≤ V _{OUT} ≤ V _{CC}	±25			mA
RECEIVER						
Receiver Differential Threshold Voltage(Note 4)	V _{TH}	-7V ≤ V _{CM} ≤ +12V,V _{CC} =+3.8v	-200		-50	mV
Receiver Input Hysteresis	ΔV _{TH}			60		mV
Receiver Output High Voltage	V _{OH}	I _O = 4mA, V _{ID} = -200mV;	V _{CC} -1.5			V
Receiver Output Low Voltage	V _{OL}	I _O = -4mA, V _{ID} = -50mV			0.4	V
Three-State Output Current at Receiver	I _{OZR}	0.4V ≤ V _O ≤ 2.4V			±1	μA
Receiver Input Resistance	R _{IN}	-7V ≤ V _{CM} ≤ +12V	96			kΩ
Receiver Output Short-Circuit Current	I _{OSR}	0V ≤ V _{RO} ≤ V _{CC}	±7		±95	mA
SUPPLY CURRENT						
Supply Current	I _{CC}	No load, RE =DI=GND or VCC	DE = V _{CC}	900	370	μA
			DE = GND		370	
Supply Current in Shutdown Mode	I _{SHDN}	DE = GND, V _{RE-} = V _{CC}		1.8	10	μA
ESD Protection						
ESD Protection(A,B)		IEC 61000-4-2 Contact model		±16		KV
		Human Body Model		±8		
ESD Protection(all other pins)		Human Body Model		±5		KV

Note 1: All currents into the device are positive; all currents out of the device are negative. All voltages are referred to device ground unless otherwise noted.

Note 2: ΔVOD and ΔVOC are the changes in VOD and VOC, respectively, when the DI input changes state.

Note 3: Maximum current level applies to peak current just prior to fold-back-current limiting; minimum current level applies during current limiting.

Note 4: V_{TH} range is $-7V \leq V_{CM} \leq +7V$, while supply $V_{CC} = +3.3V$.

Switching Characteristics

($V_{CC} = +3.3V \pm 5\%$, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Typical values are at $T_A = +25^\circ C$.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Driver Input to Output	t_{DPLH}	Figures 3 and 5, $R_{DIFF} = 54\Omega$, $C_{L1} = C_{L2} = 100pF$	250	720	1000	ns
	t_{DPHL}		250	720	1000	
Driver Output Skew $ t_{DPLH} - t_{DPHL} $	t_{DSKEW}	Figures 3 and 5, $R_{DIFF} = 54\Omega$, $C_{L1} = C_{L2} = 100pF$		-3	± 100	ns
Driver Rise or Fall Time	t_{DR}, t_{DF}	Figures 3 and 5, $R_{DIFF} = 54\Omega$, $C_{L1} = C_{L2} = 100pF$	400	700	1200	ns
Maximum Data Rate	f_{MAX}			500	2000	kbps
Driver Enable to Output High	t_{DZH}	Figures 4 and 6, $C_L = 100pF$, S_2 closed			2500	ns
Driver Enable to Output Low	t_{DZL}	Figures 4 and 6, $C_L = 100pF$, S_1 closed			2500	ns
Driver Disable Time from Low	t_{DLZ}	Figures 4 and 6, $C_L = 15pF$, S_1 closed			500	ns
Driver Disable Time from High	t_{DHZ}	Figures 4 and 6, $C_L = 15pF$, S_2 closed			500	ns
Receiver Input to Output	t_{RPLH}, t_{RPHL}	Figures 7 and 9; $ V_{ID} \geq 2.0V$; rise and fall time of $V_{ID} \leq 15ns$		127	250	ns
$ t_{RPLH} - t_{RPHL} $ Differential Receiver Skew	t_{RSKD}	Figures 7 and 9; $ V_{ID} \geq 2.0V$; rise and fall time of $V_{ID} \leq 15ns$		10	± 50	ns
Receiver Enable to Output Low	t_{RZL}	Figures 2 and 8, $C_L = 100pF$, S_1 closed		20	120	ns
Receiver Enable to Output High	t_{RZH}	Figures 2 and 8, $C_L = 100pF$, S_2 closed		20	120	ns
Receiver Disable Time from Low	t_{RLZ}	Figures 2 and 8, $C_L = 100pF$, S_1 closed		20	120	ns
Receiver Disable Time from High	t_{RHZ}	Figures 2 and 8, $C_L = 100pF$, S_2 closed		20	120	ns
Time to Shutdown	t_{SHDN}	(Note 4)	50	200	600	ns
Driver Enable from Shutdown to Output High	t_{DZH} (SHDN)	Figures 4 and 6, $C_L = 15pF$, S_2 closed			4500	ns
Driver Enable from Shutdown to Output Low	t_{DZL} (SHDN)	Figures 4 and 6, $C_L = 15pF$, S_1 closed			4500	ns
Receiver Enable from Shutdown to Output High	t_{RZH} (SHDN)	Figures 2 and 8, $C_L = 100pF$, S_2 closed			3500	ns
Receiver Enable from Shutdown to Output Low	t_{RZL} (SHDN)	Figures 2 and 8, $C_L = 100pF$, S_1 closed			3500	ns

Note 4: The device is put into shutdown by bringing RE- high and DE low. If the enable inputs are in this state for less than 50ns, the device is guaranteed not to enter shutdown. If the enable inputs are in this state for at least 600ns, the device is guaranteed to have entered shutdown.

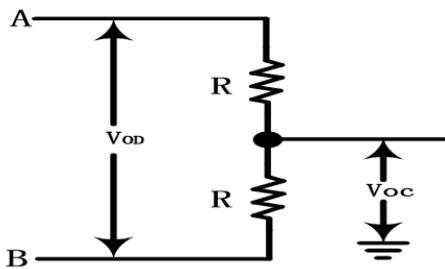


Figure 1 Driver DC Test Load

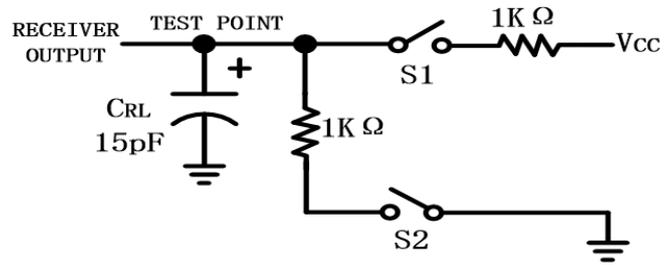


Figure 2 Receiver Enable/Disable Timing Test Load

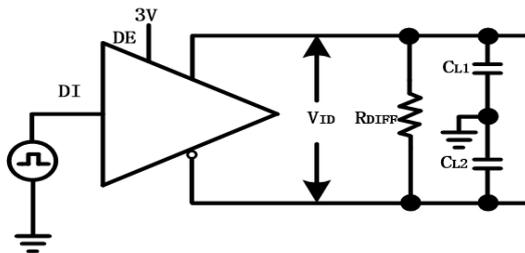


Figure 3 Driver Timing Test Circuit

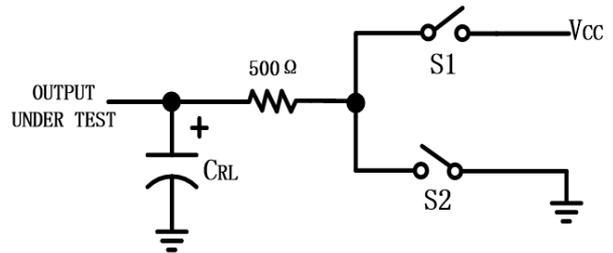


Figure 4 Driver Enable/Disable Timing Test Load

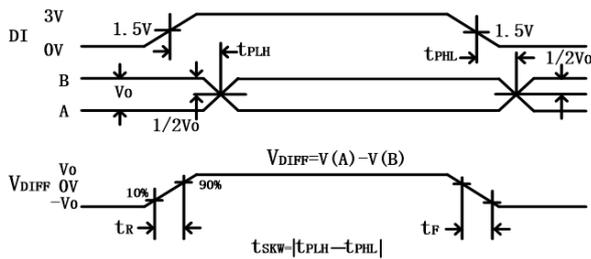


Figure 5 Driver Propagation Delays

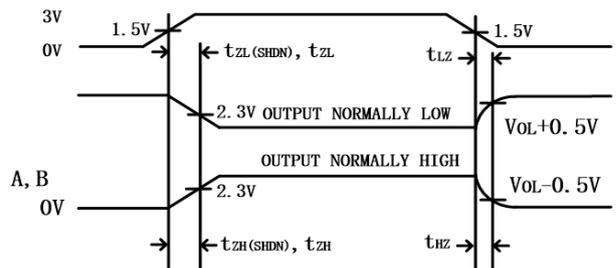


Figure 6 Driver Enable and Disable Times

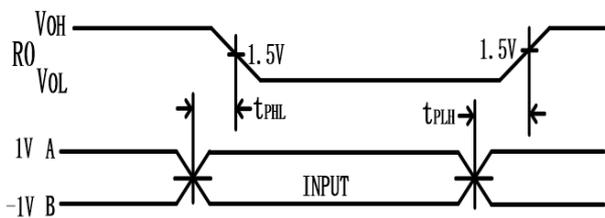


Figure 7 Receiver Propagation Delays

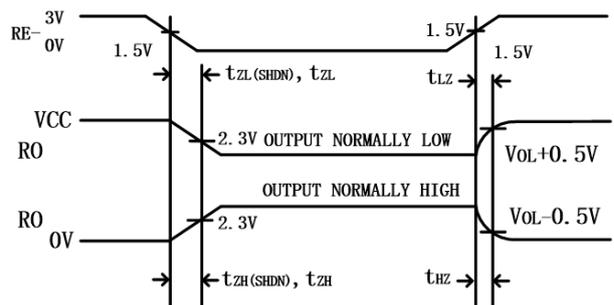


Figure 8 Receiver Enable and Disable Times

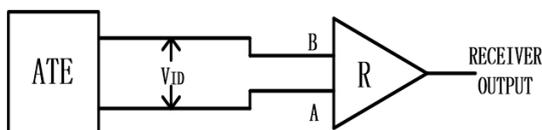


Figure 9 Receiver Propagation Delay Test Circuit

Pin Description

PIN	NAME	FUNCTION
1	RO	Receiver Output. When RE is low and if A - B \geq -50mV, RO will be high; if A - B \leq -200mV, RO will be low.
2	\overline{RE}	Receiver Output Enable. Drive \overline{RE} low to enable RO; RO is high impedance when \overline{RE} is high. Drive \overline{RE} high and DE low to enter low-power shutdown mode.
3	DE	Driver Output Enable. Drive DE high to enable driver outputs. These outputs are high impedance when DE is low. Drive RE high and DE low to enter low-power shutdown mode.
4	DI	Driver Input. With DE high, a low on DI forces non-inverting output low and inverting output high. Similarly, a high on DI forces non-inverting output high and inverting output low.
5	GND	Ground
6	A	Non-inverting Receiver Input and Non-inverting Driver Output
7	B	Inverting Receiver Input and Inverting Driver Output
8	Vcc	Positive Supply, Vcc = +3.3V \pm 5%. Bypass Vcc to GND with a 0.1 μ F capacitor.

Function Table

TRANSMITTING				
INPUTS			OUTPUTS	
\overline{RE}	DE	DI	B/Z	A/Y
X	1	1	0	1
X	1	0	1	0
0	0	X	High-Z	High-Z
1	0	X	Shutdown	

RECEIVING			
INPUTS			OUTPUTS
\overline{RE}	DE	A-B	RO
0	X	\geq -0.05V	1
0	X	\leq -0.2V	0
0	X	Open/shorted	1
1	1	X	High-Z
1	0	X	Shutdown

Applications Information

256 Transceivers on the Bus

The standard RS-485 receiver input impedance is 12k Ω (one-unit load), and the standard driver can drive up to 32 unit loads. The KY3485 family of transceivers have a 1/8-unit-load receiver input impedance (96k Ω), allowing up to 256 transceivers to be connected in parallel on one communication

line. Any combination of these devices and/or other RS-485 transceivers with a total of 32 unit loads or less can be connected to the line.

Low-Power Shutdown Mode

Low-power shutdown mode is initiated by bringing both RE- high and DE low. In shutdown, the devices typically draw only 1.8 μ A of supply current.

\overline{RE} and DE may be driven simultaneously; the parts are guaranteed not to enter shutdown if \overline{RE} is high and DE is low for less than 50ns. If the inputs are in this state for at least 600ns, the parts are guaranteed to enter shutdown.

Reduced EMI and Reflections

KY3485 is slew-rate limited, minimizing EMI and reducing reflections caused by improperly terminated cables.

Driver Output Protection

Two mechanisms prevent excessive output current and power dissipation caused by faults or by bus contention. The first, a fold-back current limit on the output stage, provides immediate protection against short circuits over the whole common-mode voltage range (see Typical Operating Characteristics). The second, a thermal shutdown circuit, forces the driver outputs into a high-impedance state if the die temperature becomes excessive.

Fail-Safe

The KY3485 guarantees a logic-high receiver output when the receiver inputs are shorted or open, or when they are connected to a terminated transmission line with all drivers disabled. This is done by setting the receiver threshold between -50mV and -200mV. If the differential receiver input voltage (A-B) is greater than or equal to -50mV, RO is logic high. If A-B is less than or equal to -200mV, RO is logic low. In the

case of a terminated bus with all transmitters disabled, the receiver's differential input voltage is pulled to 0V by the termination. With the receiver thresholds of KY3485, this results in a logic high with a 50mV minimum noise margin. Unlike previous fail-safe devices, the -50mV to -200mV threshold complies with the $\pm 200\text{mV}$ EIA/TIA-485 standard.

ESD Protection

As with all KEYSEMI devices, ESD-protection structures are incorporated on all pins to protect against electrostatic discharges encountered during handling and assembly. The driver outputs and receiver inputs of KY3485 have extra protection against static electricity. KEYSEMI's engineers have developed state-of-the-art structures to protect these pins against ESD of $\pm 20\text{kV}$ HBM without damage. The ESD structures withstand high ESD in all states: normal operation shutdown, and powered down. After an ESD event the KY3485 keep working without latch-up or damage.

ESD protection can be tested in various ways. The transmitter outputs and receiver inputs of the KY3485 are characterized for protection to the following limits:

- $\pm 20\text{kV}$ using the Human Body Model
- $\pm 15\text{kV}$ using the Contact Discharge Method specified in IEC61000-4-2

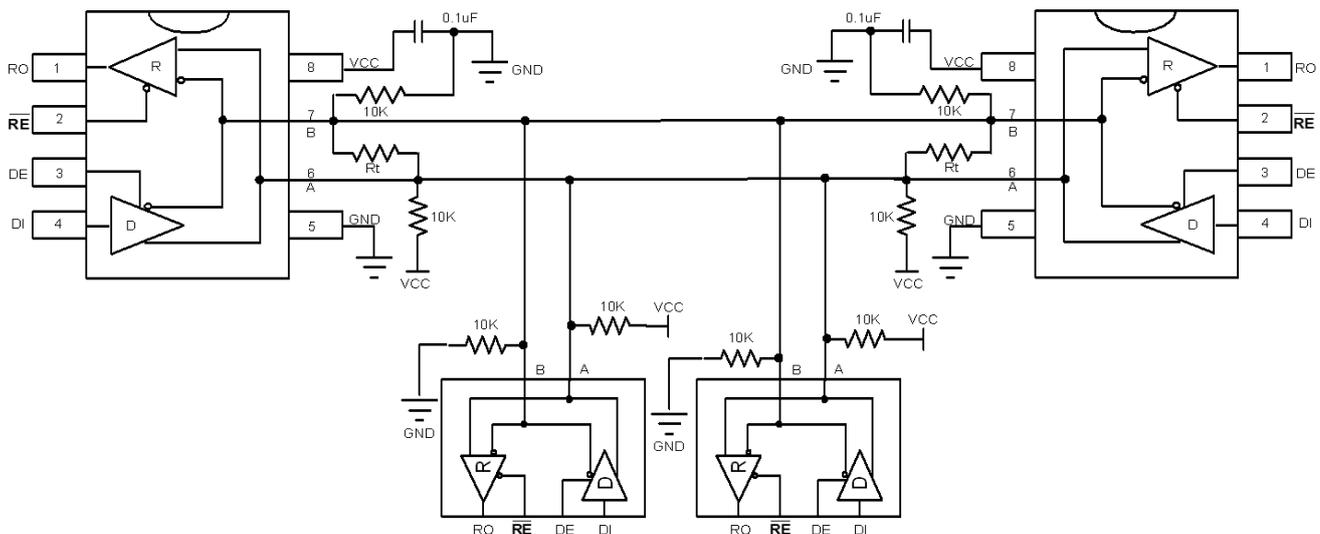
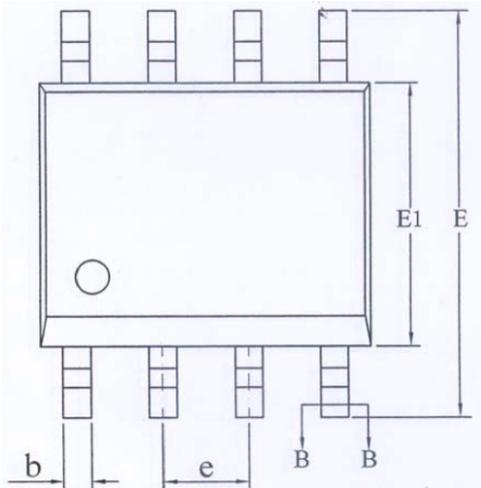


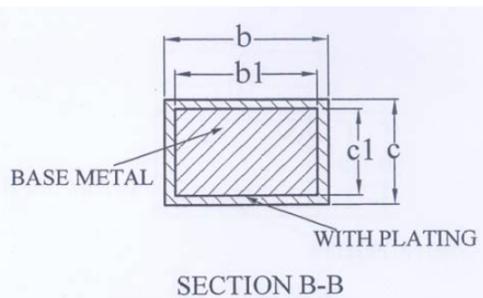
Figure 100 Typical Half-Duplex RS-485 Network

KY3485LEEN

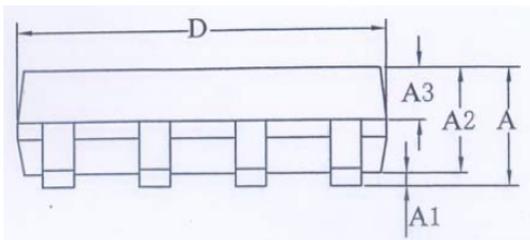
Outline Dimension



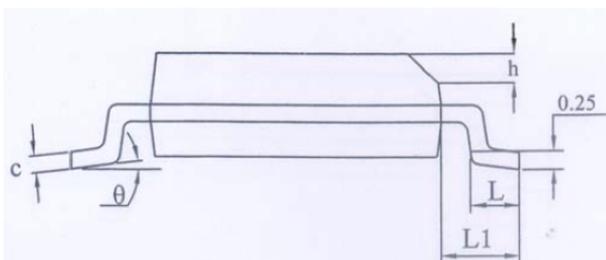
TOP VIEW



SECTION B-B



FRONT VIEW



SIDE VIEW

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.10	—	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	—	0.48
b1	0.38	0.41	0.43
c	0.21	—	0.26
c1	0.19	0.20	0.21
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC		
h	0.25	—	0.50
L	0.50 ^t	—	0.80
L1	1.0 ^t BSC		
θ	0	—	8°
LP载体尺寸 (mil)	80*80	90*90	95*130