



TECNICAS DIGITALES III



LA INSTRUMENTACIÓN VIRTUAL

Agenda

- ¿De que hablamos cuando hablamos de instrumentación virtual?.
- ¿LabView como software de desarrollo para instrumentos virtuales.
- Librerías PyVisa para desarrollo de instrumentos virtuales.

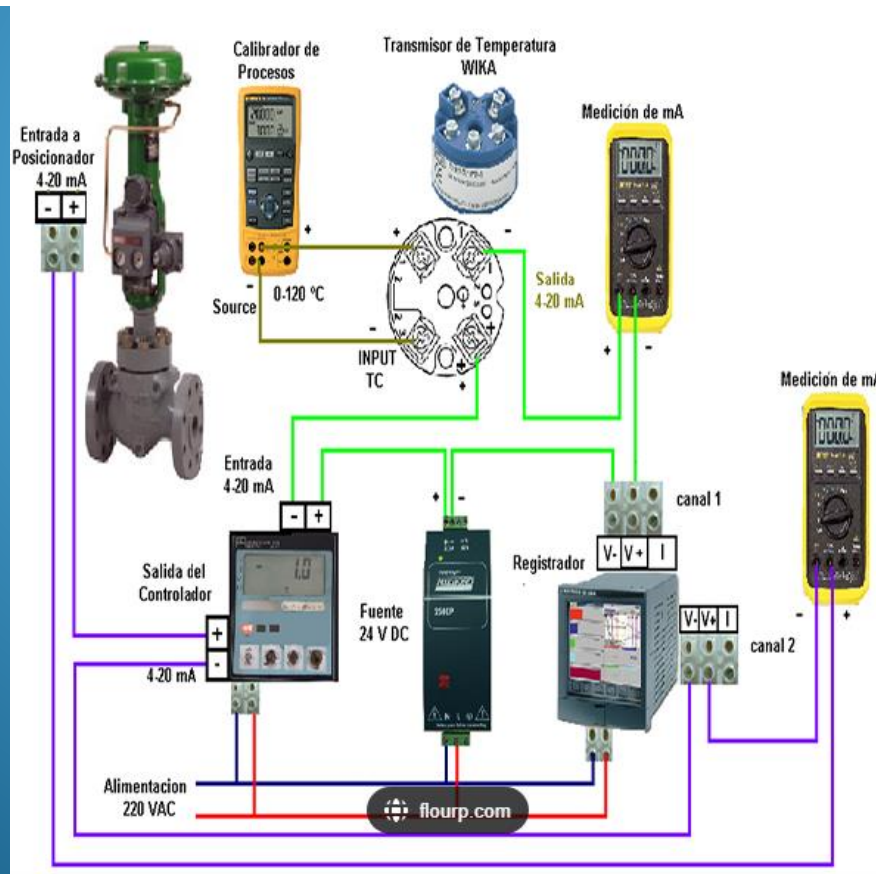
Instrumento

Un instrumento de medición es aquel que permite medir la longitud, volumen, extensión o capacidad por comparación de un elemento estandarizado el cual es tomado como referencia para posteriormente asignarle un valor numérico mediante algún instrumento graduado con dicha unidad.



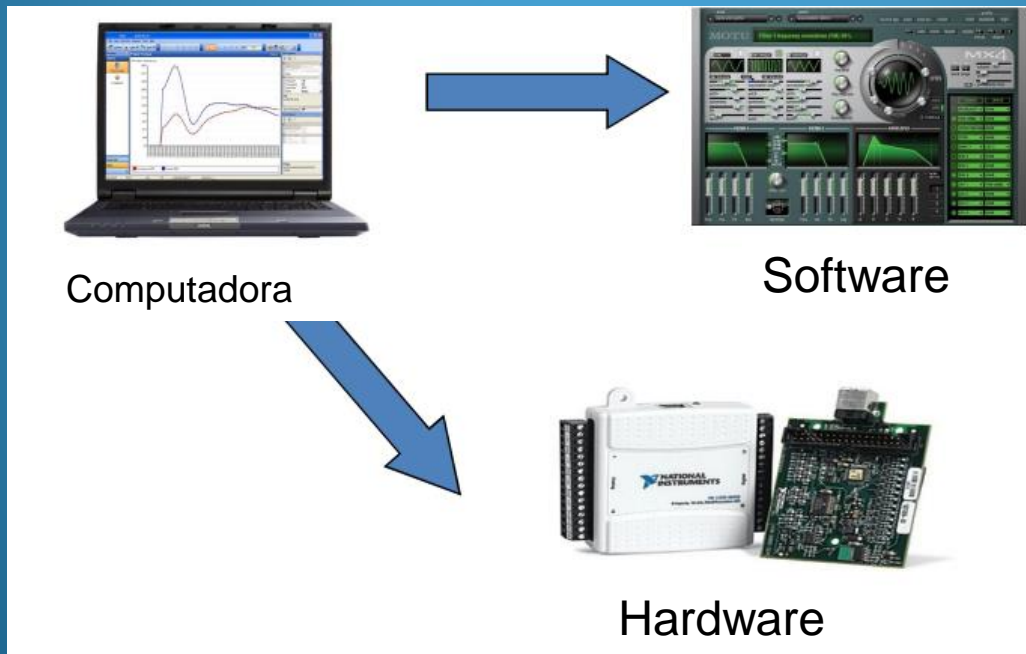
Instrumentación

Instrumentación es el proceso en el que el conjunto de varios instrumentos eléctricos/electrónicos, de medición y control interconectados para medir, analizar y controlar las magnitudes físicas eléctricas y no eléctricas.



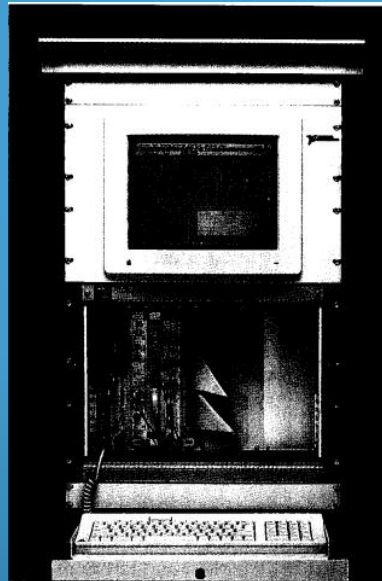
Paradigma de la instrumentación virtual

Un instrumento virtual es aquel cuya funcionalidad es determinada por software.



Historia de los instrumentos virtuales

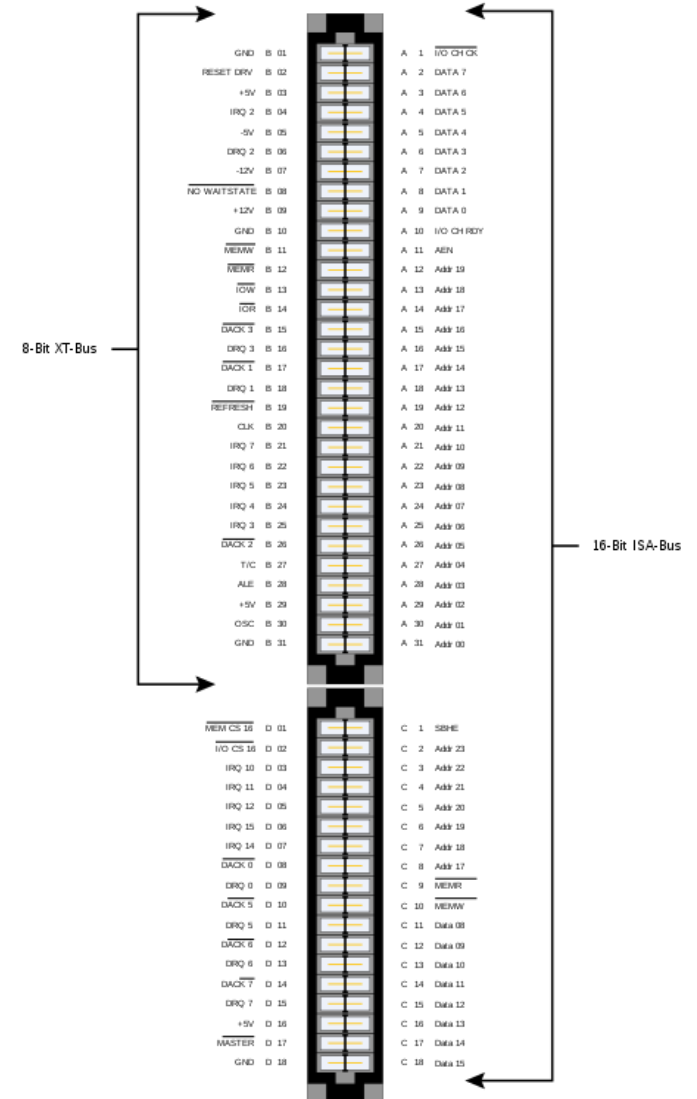
El concepto de instrumentos virtuales nace a fines de 1970, cuando la tecnología de los microprocesadores habilita a que la funcionalidad de una maquina sea fácilmente modificable por software. Hasta principios de los 80 consistían en conectar instrumentos tradicionales a la PC



M. Santori, "An instrument that isn't really", IEEE Spectrum 27(8), 36 - 39 (1990).

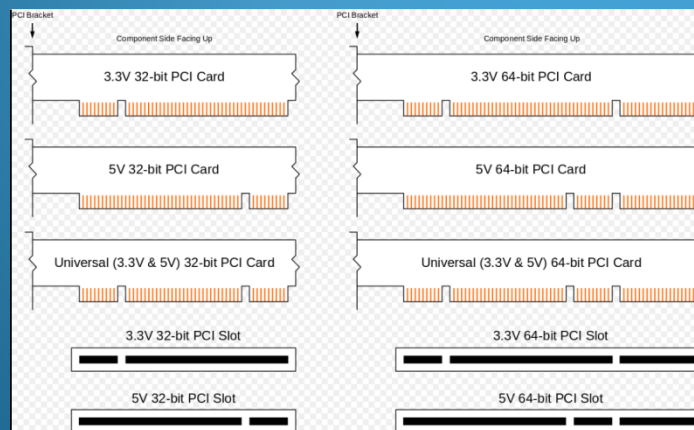
Primeros instrumentos e interfaz paralelo

BUS ISA (Industry Standard Architecture)



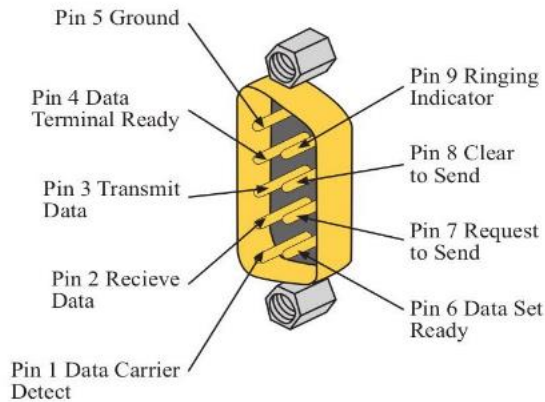
Interfaz paralelo

BUS PCI (Peripheral Component Interconnect)

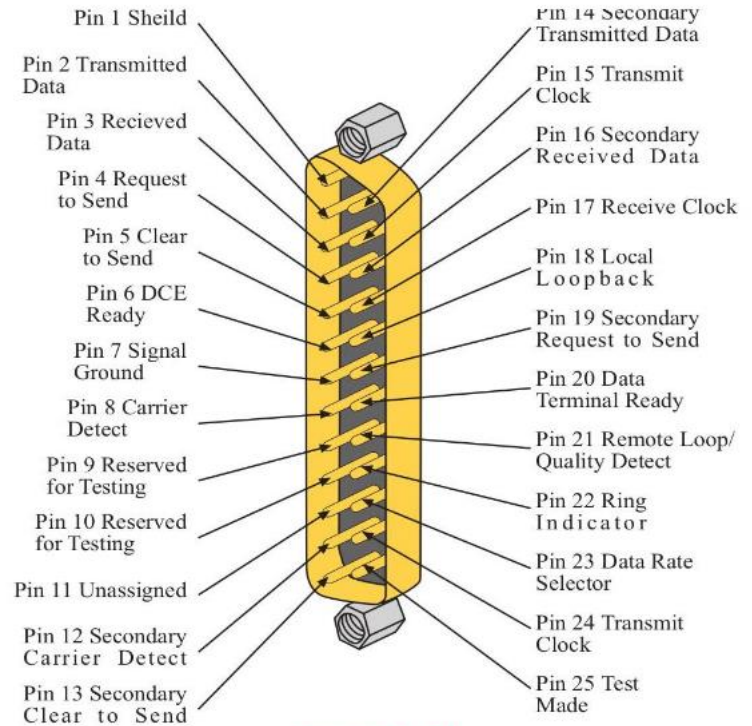


Rear of Computer			
Test Clock	- B0	A0	- Test Reset
Test Data	- B1	A1	- +15V
Test Data Input	- B2	A2	- Test Mode Select
Test Data Output	- B3	A3	- Test Data Input
+Vcc	- B4	A4	- +Vcc
Interrupt 0	- B5	A5	- Interrupt 0
Interrupt 1	- B6	A6	- Interrupt 1
Interrupt 2	- B7	A7	- Interrupt 2
Reserved	- B8	A8	- +Vcc
Reserved	- B9	A9	- Reserved
Reserved	- B10	A10	- +Vcc
Reserved	- B11	A11	- Reserved
.....			
Reserved	- B12	A12	- Reserved
Ground	- B13	A13	- Reset
Clock	- B14	A14	- +Vcc
Ground	- B15	A15	- +Vcc
Request	- B16	A16	- +Vcc
+Vcc	- B17	A17	- +Vcc
Address 0	- B18	A18	- +Vcc
Address 1	- B19	A19	- +Vcc
Address 2	- B20	A20	- +Vcc
Address 3	- B21	A21	- +Vcc
Address 4	- B22	A22	- +Vcc
Address 5	- B23	A23	- +Vcc
Address 6	- B24	A24	- +Vcc
Address 7	- B25	A25	- +Vcc
Address 8	- B26	A26	- +Vcc
Address 9	- B27	A27	- +Vcc
Address 10	- B28	A28	- +Vcc
Address 11	- B29	A29	- +Vcc
Address 12	- B30	A30	- +Vcc
Address 13	- B31	A31	- +Vcc
Address 14	- B32	A32	- +Vcc
Address 15	- B33	A33	- +Vcc
Address 16	- B34	A34	- +Vcc
Address 17	- B35	A35	- +Vcc
Address 18	- B36	A36	- +Vcc
Address 19	- B37	A37	- +Vcc
Address 20	- B38	A38	- +Vcc
Address 21	- B39	A39	- +Vcc
Address 22	- B40	A40	- +Vcc
Address 23	- B41	A41	- +Vcc
Address 24	- B42	A42	- +Vcc
Address 25	- B43	A43	- +Vcc
Address 26	- B44	A44	- +Vcc
Address 27	- B45	A45	- +Vcc
Address 28	- B46	A46	- +Vcc
Address 29	- B47	A47	- +Vcc
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Address 31	- B49	A49	- +Vcc
Address 32	- B50	A50	- +Vcc
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Address 36	- B54	A54	- +Vcc
Address 37	- B55	A55	- +Vcc
Address 38	- B56	A56	- +Vcc
Address 39	- B57	A57	- +Vcc
Address 40	- B58	A58	- +Vcc
Address 41	- B59	A59	- +Vcc
Address 42	- B60	A60	- +Vcc
Address 43	- B61	A61	- +Vcc
Address 44	- B62	A62	- +Vcc
Address 45	- B63	A63	- +Vcc
Address 46	- B64	A64	- +Vcc
Address 47	- B65	A65	- +Vcc
Address 48	- B66	A66	- +Vcc
Address 49	- B67	A67	- +Vcc
Address 50	- B68	A68	- +Vcc
Address 51	- B69	A69	- +Vcc
Address 52	- B70	A70	- +Vcc
Address 53	- B71	A71	- +Vcc
Address 54	- B72	A72	- +Vcc
Address 55	- B73	A73	- +Vcc
Address 56	- B74	A74	- +Vcc
Address 57	- B75	A75	- +Vcc
Address 58	- B76	A76	- +Vcc
Address 59	- B77	A77	- +Vcc
Address 60	- B78	A78	- +Vcc
Address 61	- B79	A79	- +Vcc
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Address 63	- B81	A81	- +Vcc
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Address 140	- B158	A158	- +Vcc
Address 141	- B159	A159	- +Vcc
Address 142	- B160	A160	- +Vcc
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Address 144	- B162	A162	- +Vcc
Address 145	- B163	A163	- +Vcc
Address 146	- B164	A164	- +Vcc
Address 147	- B165	A165	- +Vcc
Address 148	- B166	A166	- +Vcc
Address 149	- B167	A167	- +Vcc
Address 150	- B168	A168	- +Vcc
Address 151	- B169	A169	- +Vcc
Address 152	- B170	A170	- +Vcc
Address 153	- B171	A171	- +Vcc
Address 154	- B172	A172	- +Vcc
Address 155	- B173	A173	- +Vcc
Address 156	- B174	A174	- +Vcc
Address 157	- B175	A175	- +Vcc
Address 158	- B176	A176	- +Vcc
Address 159	- B177	A177	- +Vcc
Address 160	- B178	A178	- +Vcc
Address 161	- B179	A179	- +Vcc
Address 162	- B180	A180	- +Vcc
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Address 165	- B183	A183	- +Vcc
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Address 171	- B189	A189	- +Vcc
Address 172	- B190	A190	- +Vcc
Address 173	- B191	A191	- +Vcc
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Address 195	- B213	A213	- +Vcc
Address 196	- B214	A214	- +Vcc
Address 197	- B215	A215	- +Vcc
Address 198	- B216	A216	- +Vcc
Address 199	- B217	A217	- +Vcc
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Address 203	- B221	A221	- +Vcc
Address 204	- B222	A222	- +Vcc
Address 205	- B223	A223	- +Vcc
Address 206	- B224	A224	- +Vcc
Address 207	- B225	A225	- +Vcc
Address 208	- B226	A226	- +Vcc
Address 209	- B227	A227	- +Vcc
Address 210	- B228	A228	- +Vcc
Address 211	- B229	A229	- +Vcc
Address 212	- B230	A230	- +Vcc
Address 213	- B231	A231	- +Vcc
Address 214	- B232	A232	- +Vcc
Address 215	- B233	A233	- +Vcc
Address 216	- B234	A234	- +Vcc
Address 217	- B235	A235	- +Vcc
Address 218	- B236	A236	- +Vcc
Address 219	- B237	A237	- +Vcc
Address 220	- B238	A238	- +Vcc
Address 221	- B239	A239	- +Vcc
Address 222	- B240	A240	- +Vcc
Address 223	- B241	A241	- +Vcc
Address 224	- B242	A242	- +Vcc
Address 225	- B243	A243	- +Vcc
Address 226	- B244	A244	- +Vcc
Address 227	- B245	A245	- +Vcc
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Address 230	- B248	A248	- +Vcc
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Address 232	- B250	A250	- +Vcc
Address 233	- B251	A251	- +Vcc
Address 234	- B252	A252	- +Vcc
Address 235	- B253	A253	- +Vcc
Address 236	- B254	A254	- +Vcc
Address 237	- B255	A255	- +Vcc
Address 238	- B256	A256	- +Vcc
Address 239	- B257	A257	- +Vcc
Address 240	- B258	A258	- +Vcc
Address 241	- B259	A259	- +Vcc
Address 242	- B260	A260	- +Vcc
Address 243	- B261	A261	- +Vcc
Address 244	- B262	A262	- +Vcc
Address 245	- B263	A263	- +Vcc
Address 246	- B264	A264	- +Vcc
Address 247	- B265	A265	- +Vcc
Address 248	- B266	A266	- +Vcc
Address 249	- B267	A267	- +Vcc
Address 250	- B268	A268	- +Vcc
Address 251	- B269	A269	- +Vcc
Address 252	- B270	A270	- +Vcc
Address 253	- B271	A271	- +Vcc
Address 254	- B272	A272	- +Vcc
Address 255	- B273	A273	- +Vcc
Address 256	- B274	A274	- +Vcc
Address 257	- B275	A275	- +Vcc
Address 258	- B276	A276	- +Vcc
Address 259	- B277	A277	- +Vcc
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Address 263	- B281	A281	- +Vcc
Address 264	- B282	A282	- +Vcc
Address 265	- B283	A283	- +Vcc
Address 266	- B284	A284	- +Vcc
Address 267	- B285	A285	- +Vcc
Address 268	- B286	A286	- +Vcc
Address 269	- B287	A287	- +Vcc
Address 270	- B288	A288	- +Vcc
Address 271	- B289	A289	- +Vcc
Address 272	- B290	A290	- +Vcc
Address 273	- B291	A291	- +Vcc
Address 274	- B292	A292	- +Vcc
Address 275	- B293	A293	- +Vcc
Address 276	- B294	A294	- +Vcc
Address 277	- B295	A295	- +Vcc
Address 278	- B296	A296	- +Vcc
Address 279	- B297	A297	- +Vcc
Address 280	- B298	A298	- +Vcc
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Address 296	- B314	A314	- +Vcc</

Interfaces serie RS232

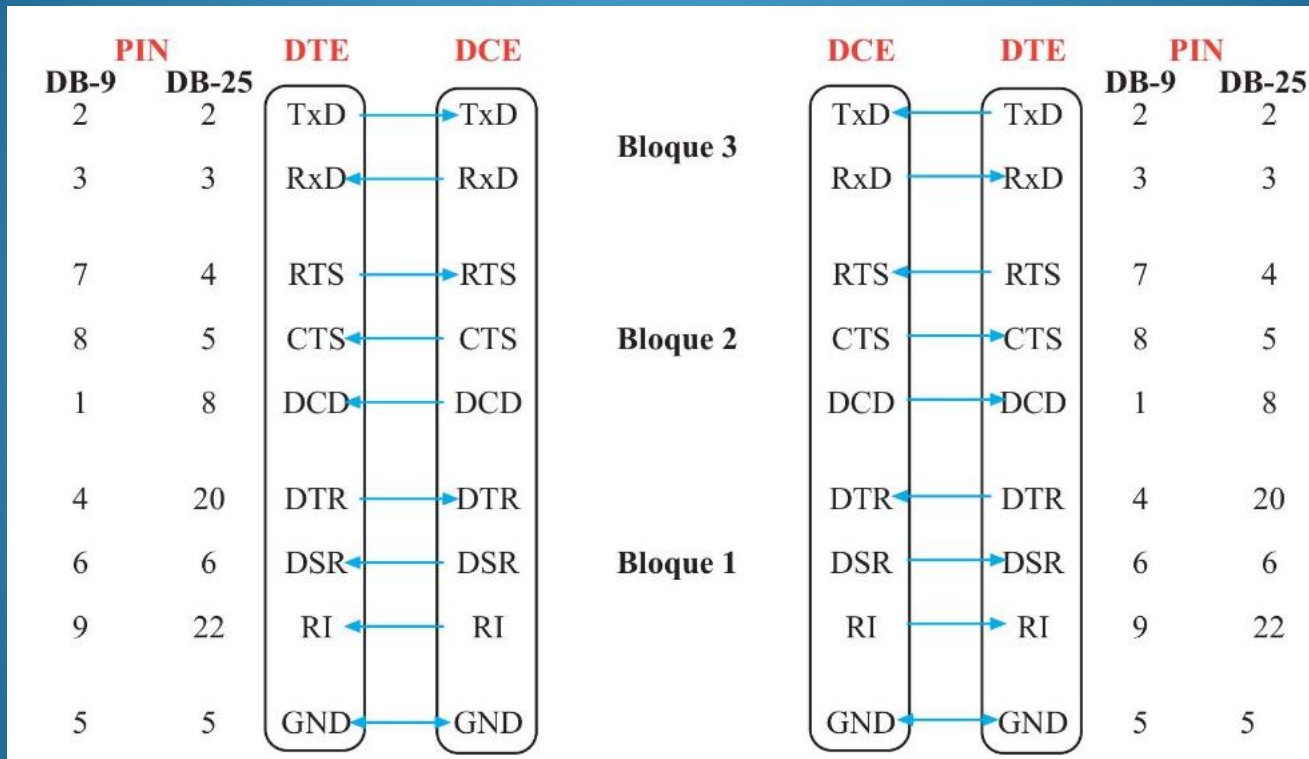


Cannon DB-9



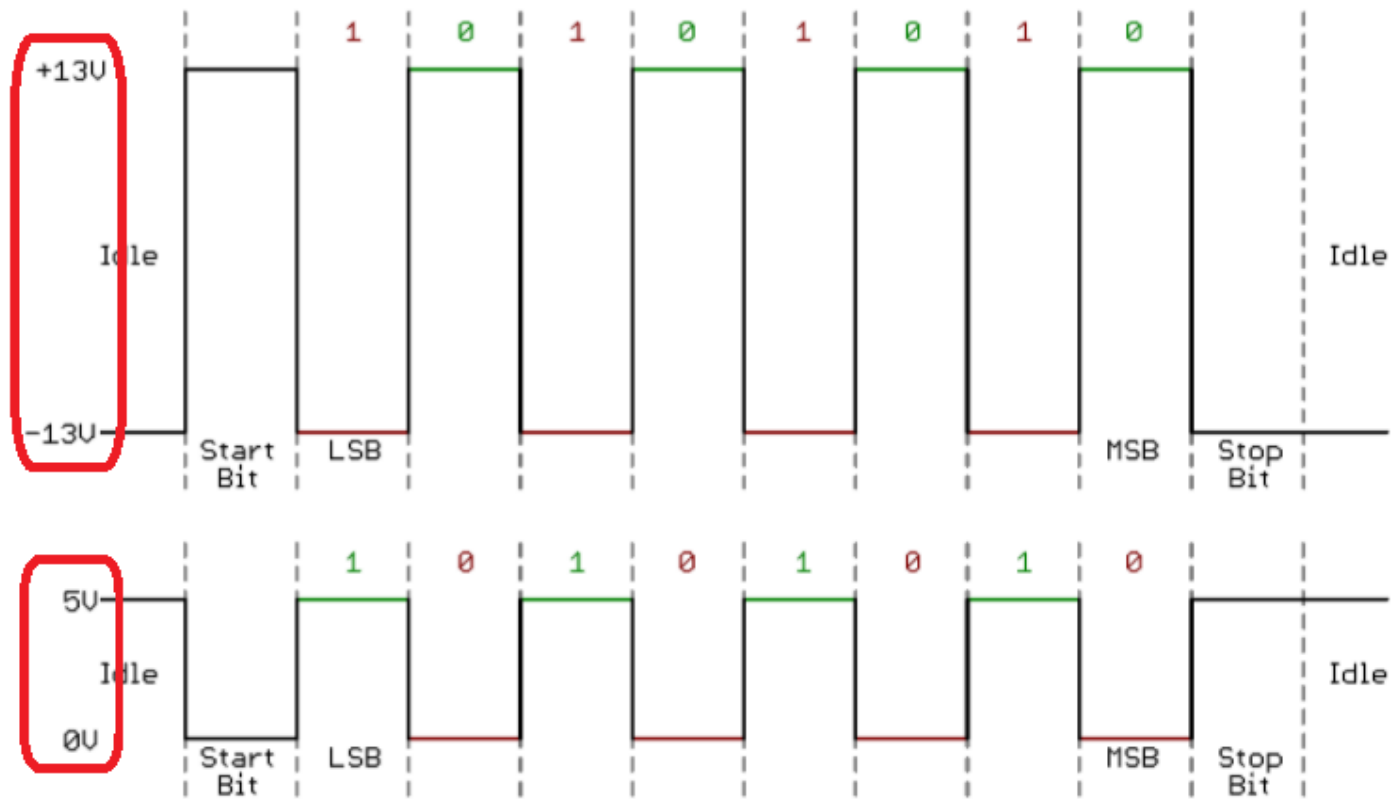
Cannon DB-25

Interfaces serie RS232



Interfaces serie

RS232



This timing diagram shows both a TTL (bottom) and RS-232 signal sending 0b01010101

Nota de aplicación RS232



Interface Circuits for TIA/EIA-232-F

Design Notes

RS232- Detalles de la señal

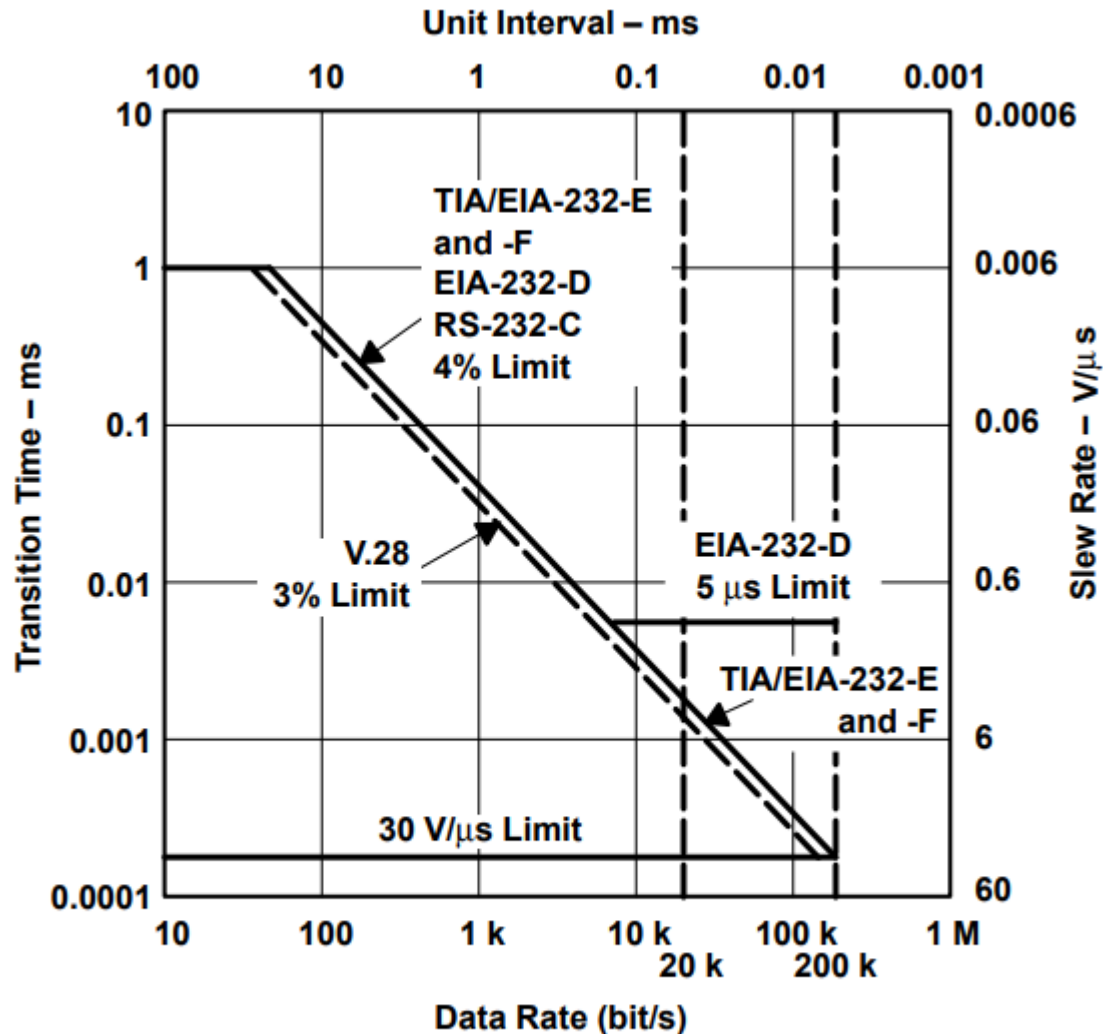


Figure 2. 232 Transition Time vs Data Rate

Especificaciones electrica

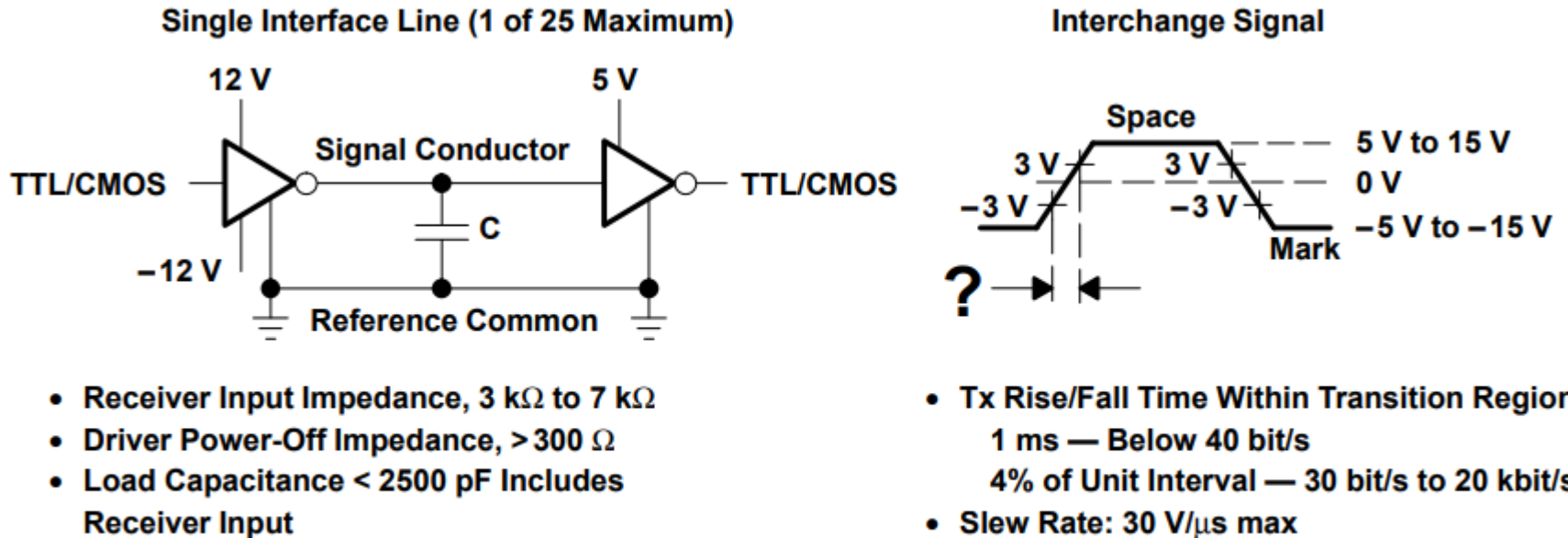
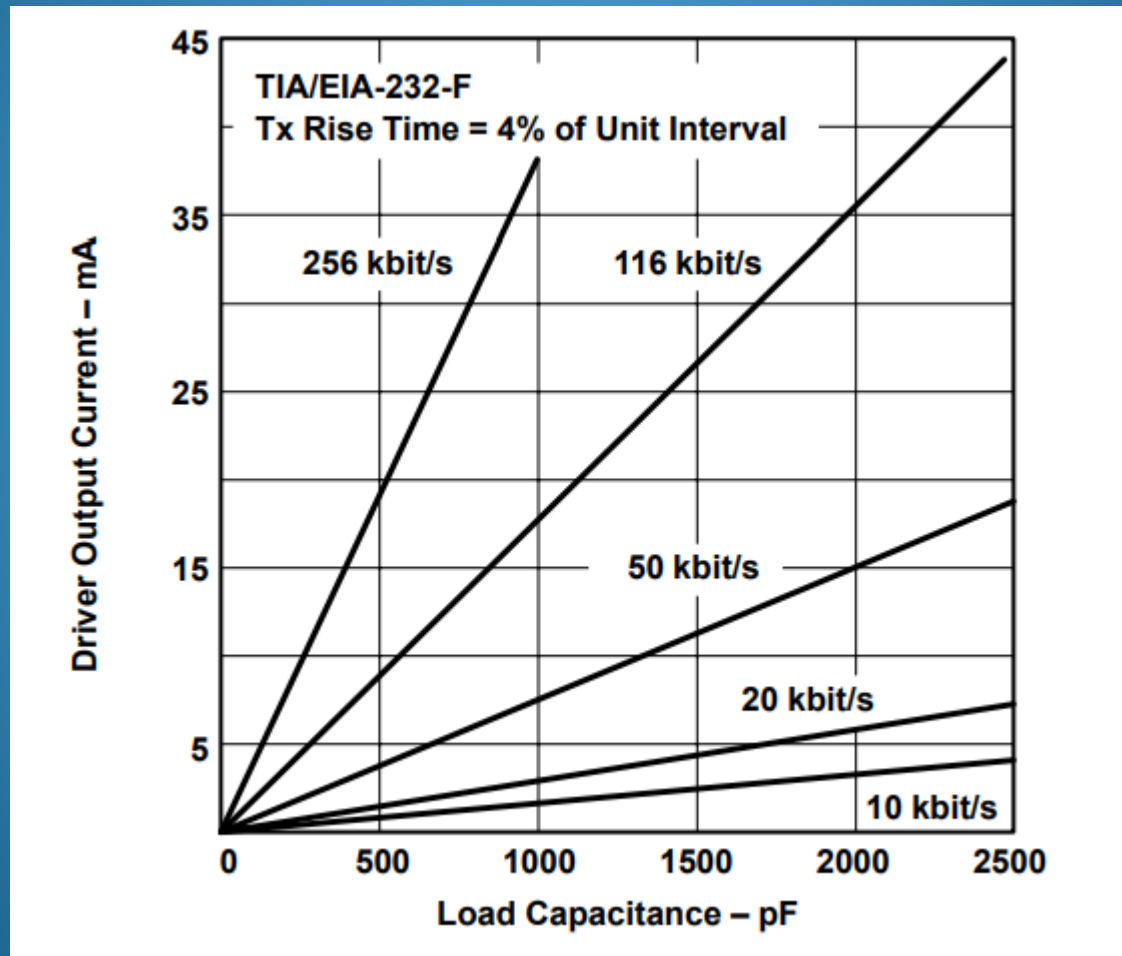
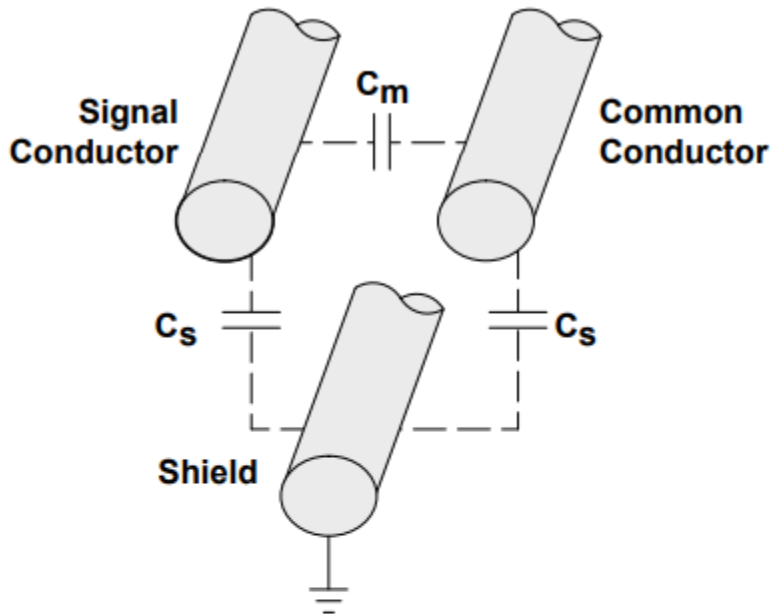


Figure 3. TIA/EIA-232-F Electrical Specification

RS232 – Relación entre la capacidad distribuida del cable y la longitud



RS232 – Calculo de la distancia máxima de comunicaciones



Data-Rate Calculation

$$\text{Unit Interval} = \frac{1}{3} \frac{0.04}{C_C \ln \left(\frac{I_O + 1}{I_O - 1} \right)}$$

I_O = Short-Circuit Current of Driver

Line-Length Calculation

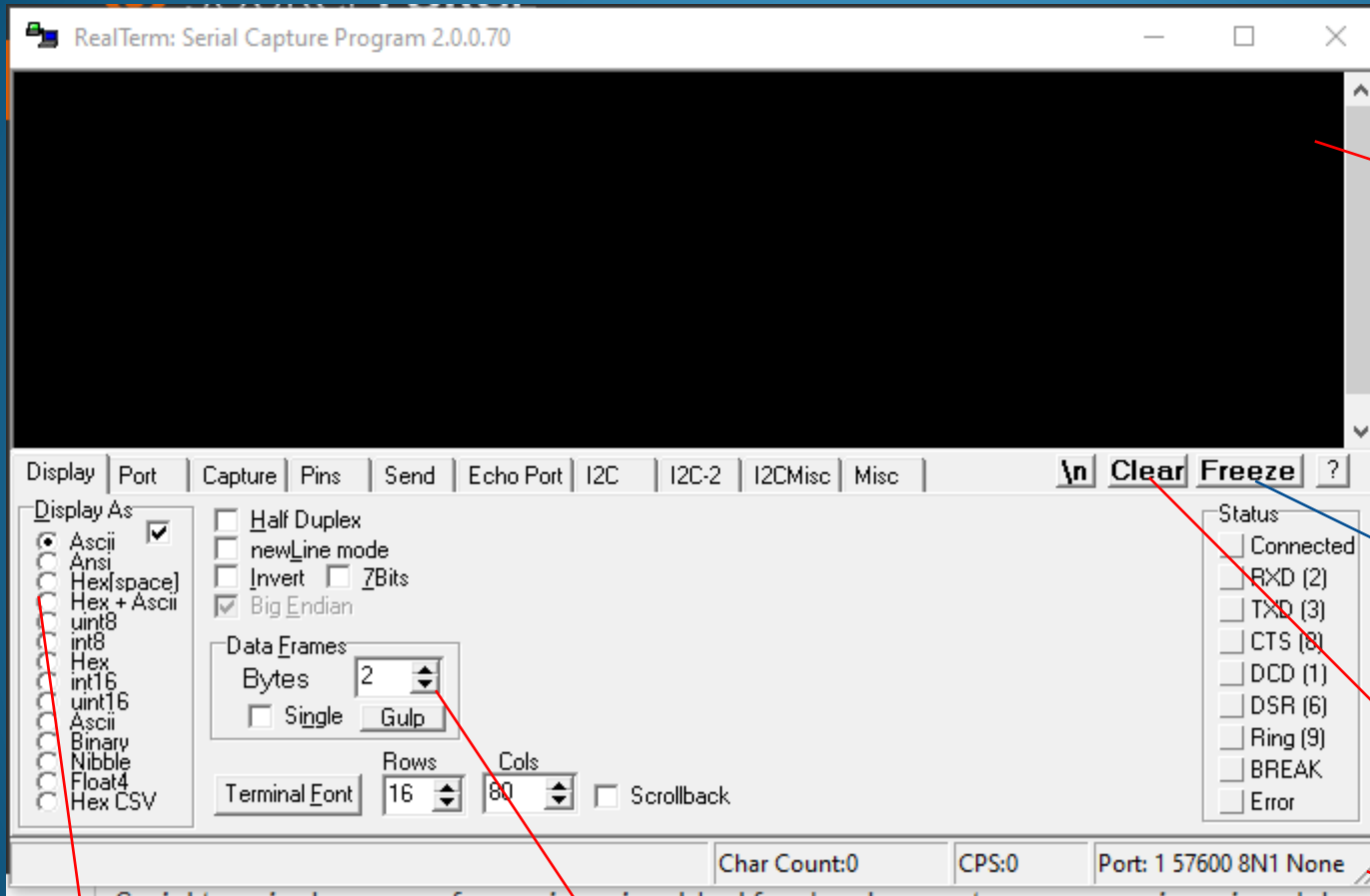
Maximum Capacitance = 2500 pF
 Receiver I/P Capacitance < 20 pF
 Maximum Line Capacitance = 2480 pF

Total Line Capacitance/m $C_C = C_M + C_S$
 Mutual Capacitance of Cable/m $C_M \approx 100 \text{ pF}$
 Stray Capacitance/m $C_S \approx 200 \text{ pF}$

Maximum Line Length = $2480 / C_C$
 Standard Cable C_M = 24 pF/m
 Maximum Line Length Shielded = 10 Meters

Figure 5. Calculating Line Length and Data Rate

RS232 – RealTerm



Muestra los
datos de entrada
y de salida
(si esta activo el “echo”)

Congela la
pantalla

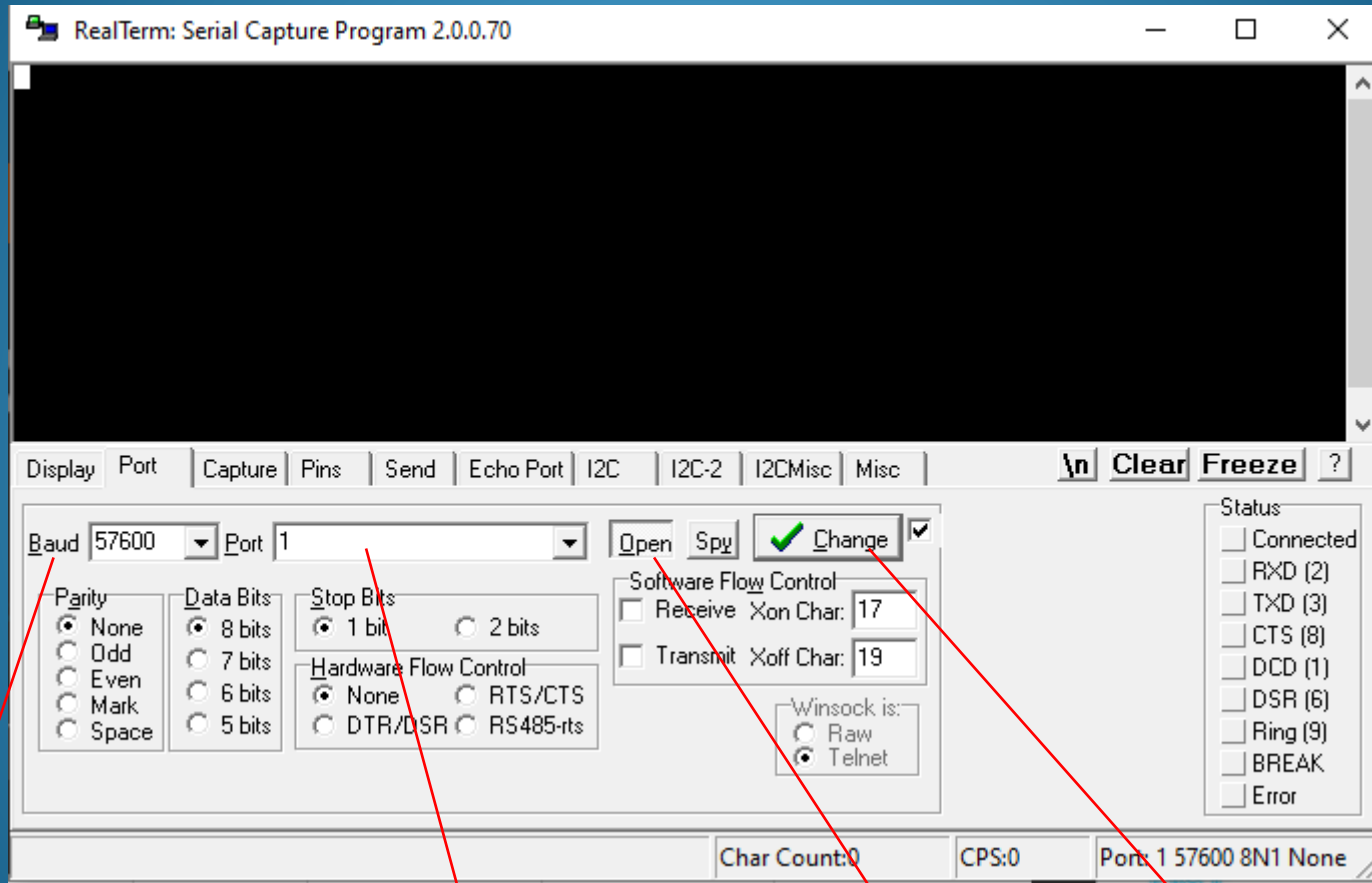
Limpia pantalla

Como mostrar el dato

Permite especificar el largo de la
trama de datos

Datos del puerto

RS232 – RealTerm



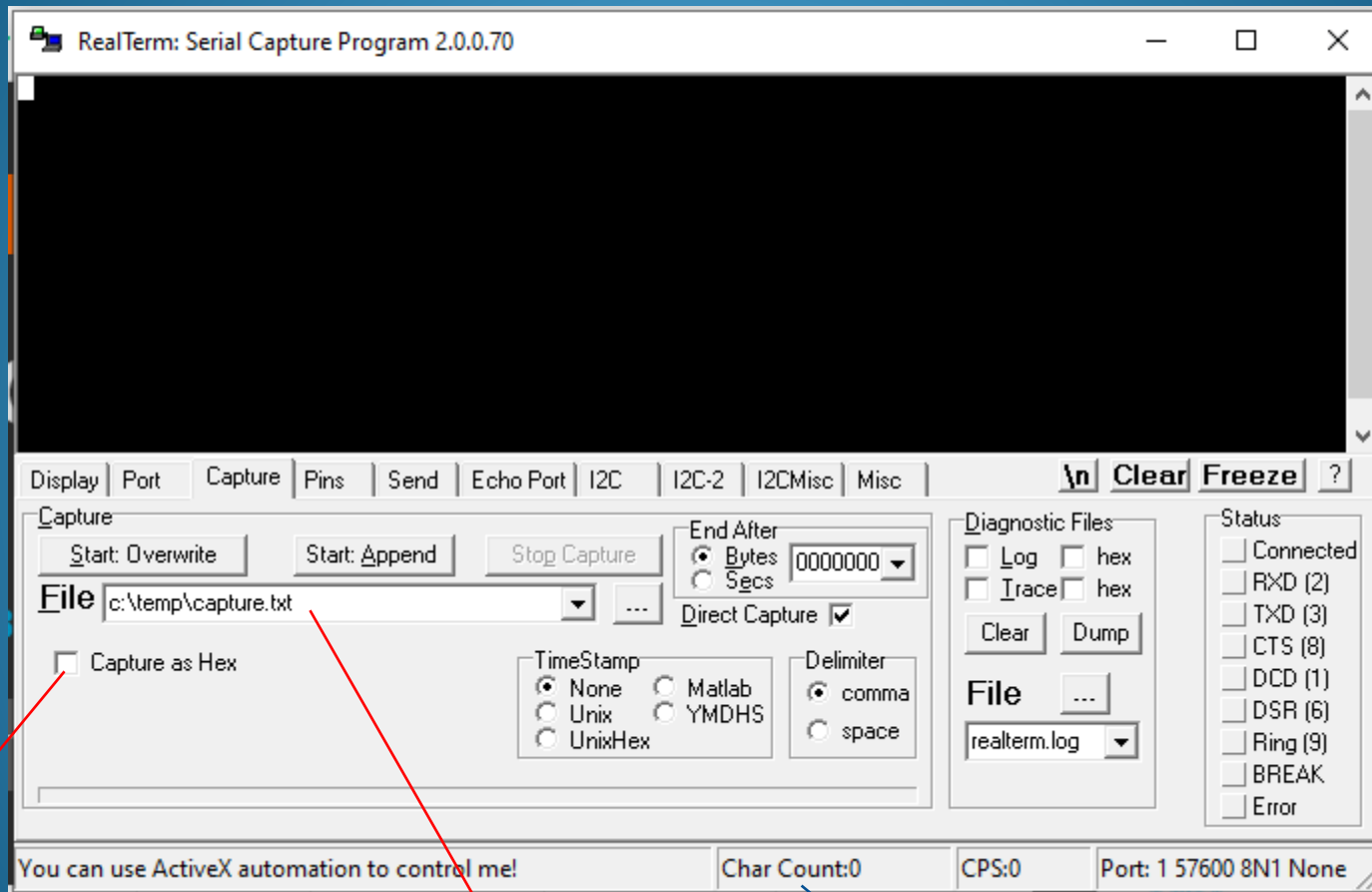
Velocidad de comunicaciones

Puerto de comunicaciones

Abre/cierra el puerto

Aplica cambios

RS232 – RealTerm

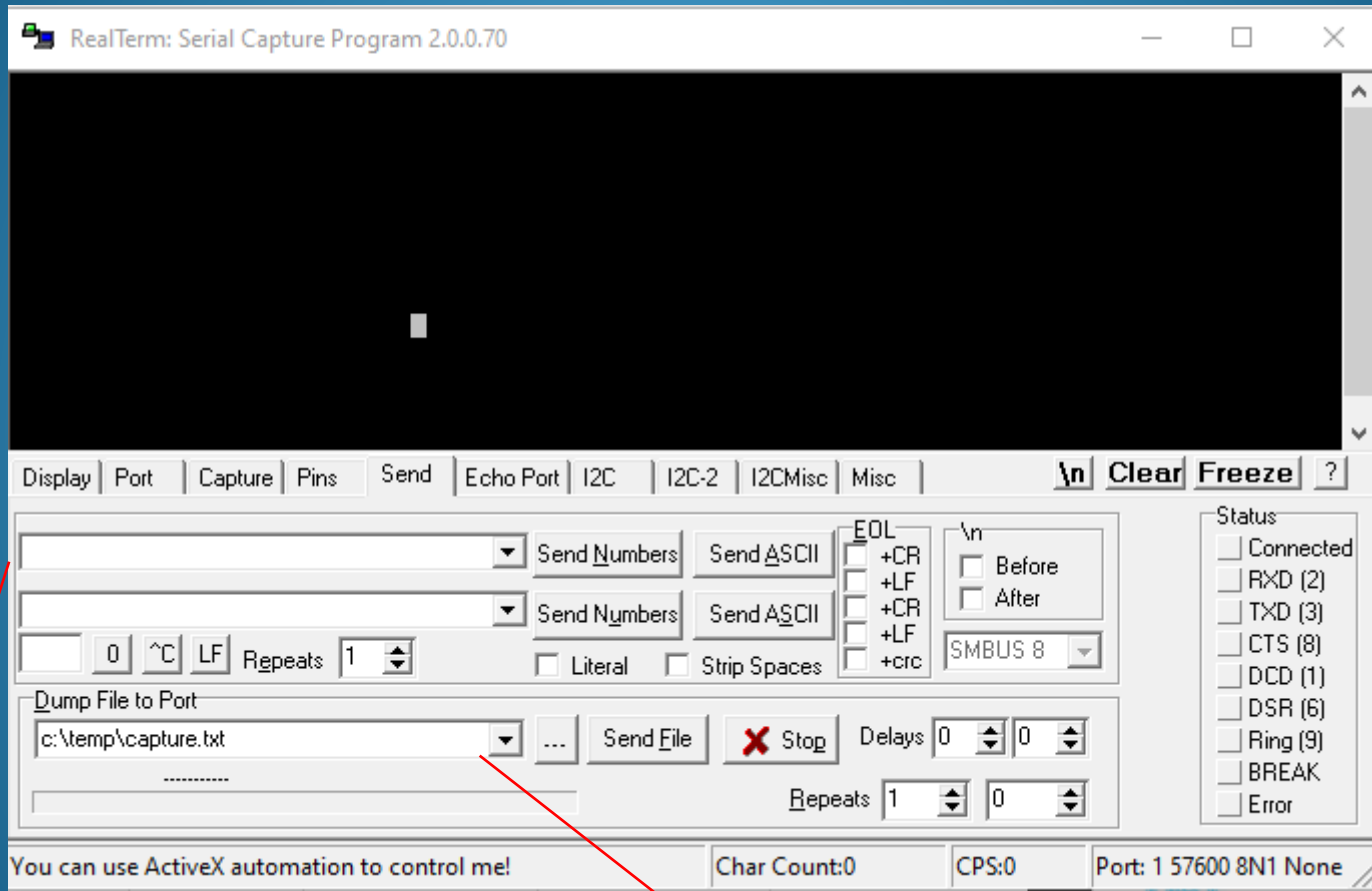


Forma de
almacenamiento,
hexadecimal
o binario

Ubicación y nombre de archivo

Caracteres adquiridos

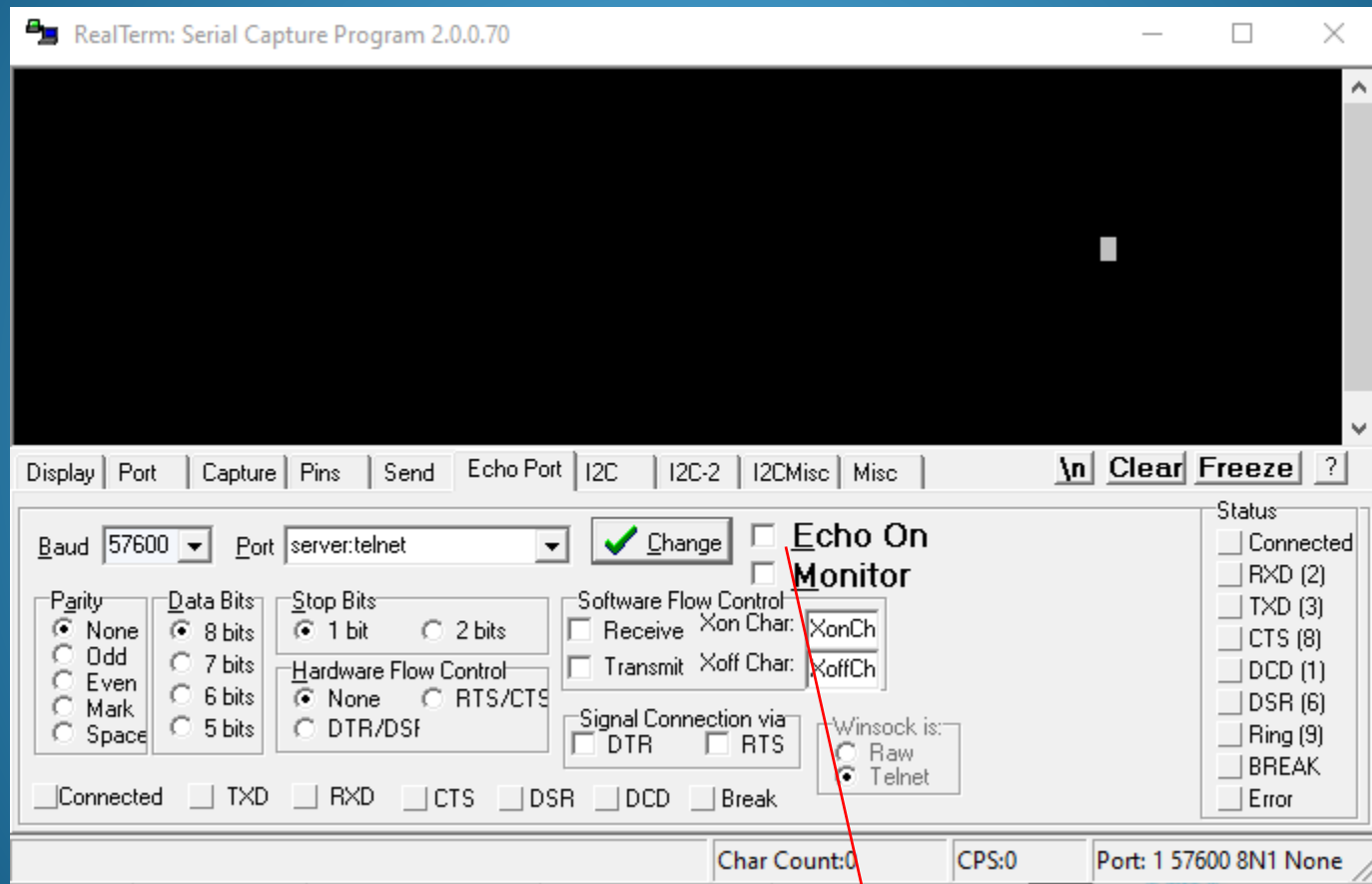
RS232 – RealTerm



Permite enviar una cadena de datos, puede enviarse en ASCII o en hexadecimal

Permite enviar un archivo completo

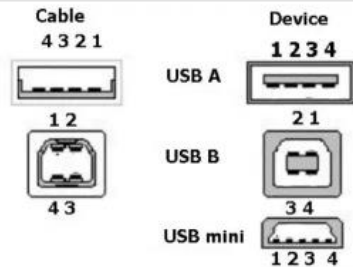
RS232 – RealTerm



Permite ver lo que se envía por el terminal

Interfaces serie

USB (Universal Serial Bus)

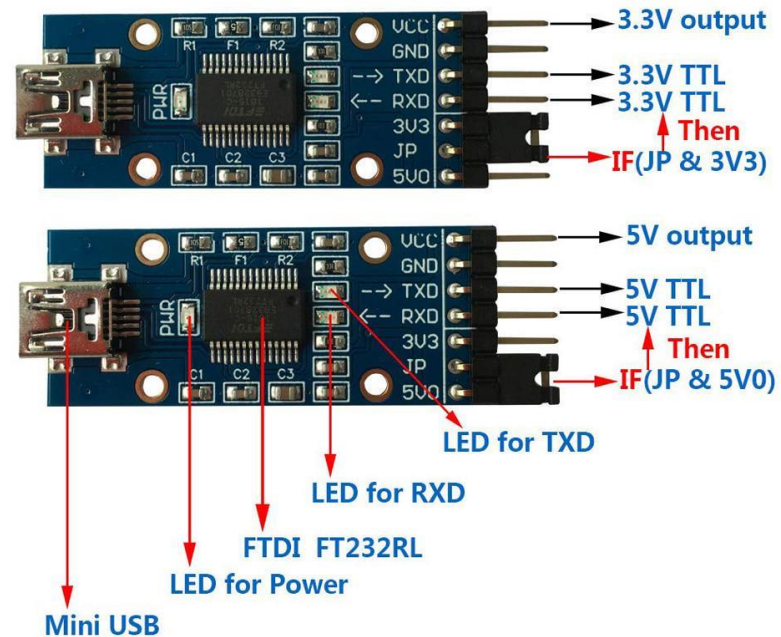


Pin	Signal	Color	Description
1	VCC	Red	+5V
2	D-	White	Data -
3	D+	Green	Data +
4	GND	Black	Ground

Pinouts for USB 2.0 cables and connectors.



Interfaces serie RS232 -USB



Interfaces serie RS232 -USB



Nuevo | +5 vendidos

**Adaptador Conversor Usb A
Uart Rs232 Arduino Pic Arm**



★★★★★ (1)

\$ 1.500

en 12x \$ 254⁹⁹

[Ver los medios de pago](#)

Llega entre el **5 y 12 abr.** por \$ 1.269⁹⁹
~~\$ 1.769⁹⁹~~

Beneficio Mercado Puntos

[Ver más formas de entrega](#)

Devolución gratis

Tenés 30 días desde que lo recibís.

[Conocer más](#)

Stock disponible

Cantidad: **1 unidad** ▾ (4 disponibles)

Interfaces serie RS232 -USB



Nuevo | +50 vendidos

**Conversor Usb A Rs232
Cp2102 Arduino Nueva
Córdoba**

★★★★★ (3)

\$ 2.175³⁷

en 12x \$ 369⁷⁹

[Ver los medios de pago](#)

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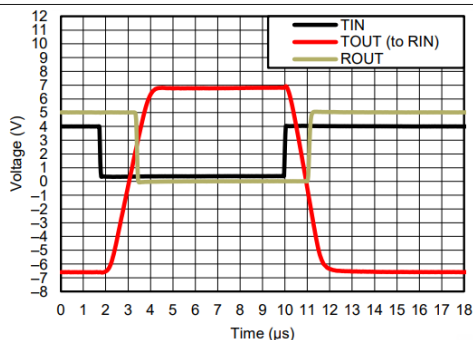
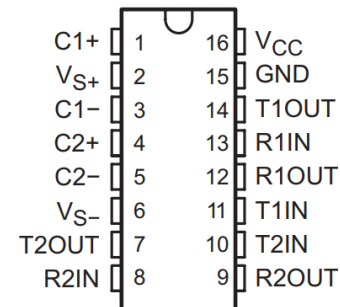


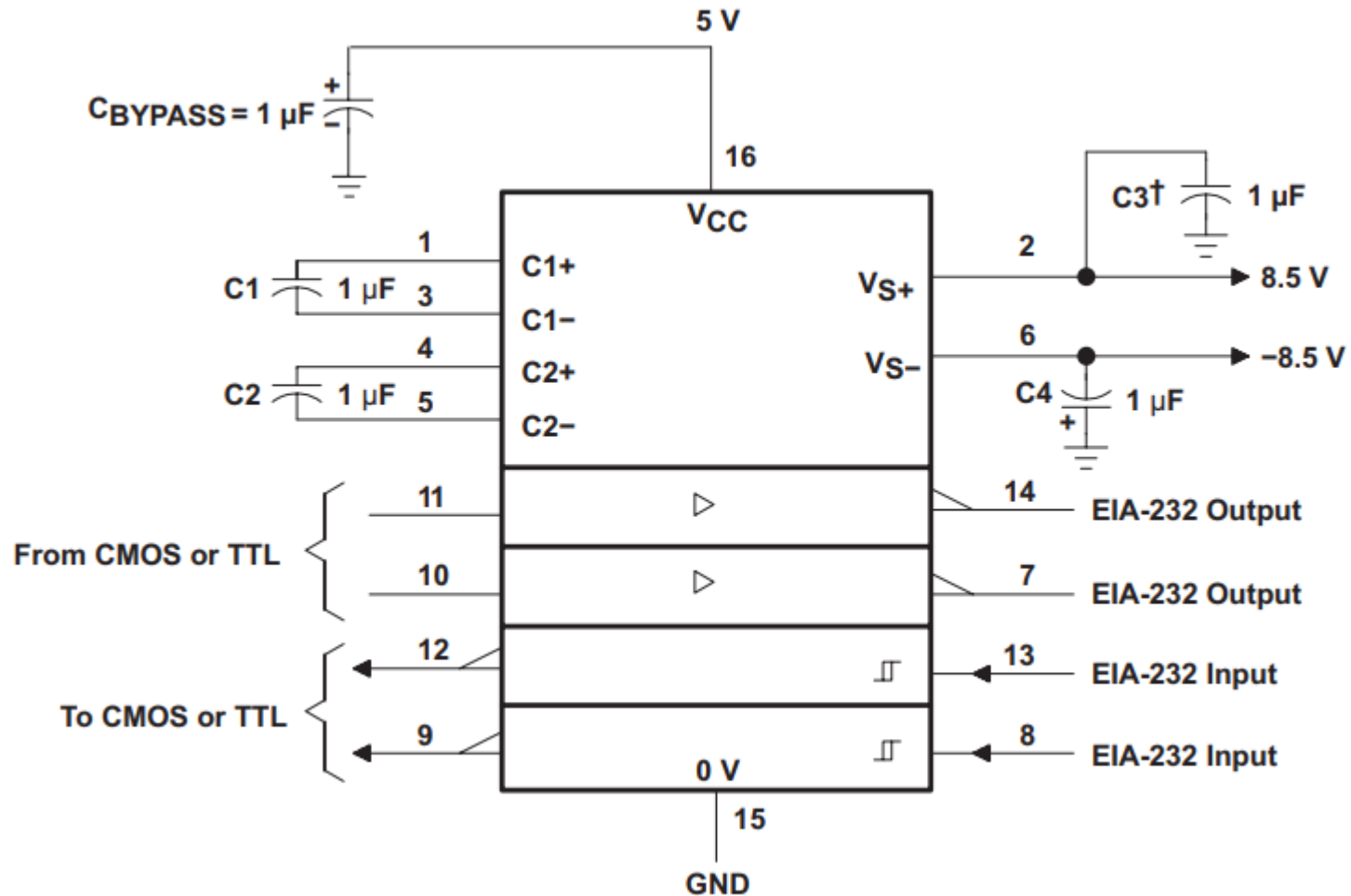
Figure 2. Driver to Receiver Loopback Timing Waveform

MAX232 . . . D, DW, N, OR NS PACKAGE
MAX232I . . . D, DW, OR N PACKAGE
(TOP VIEW)



PIN		TYPE	DESCRIPTION
NAME	NO.		
C1+	1	—	Positive lead of C1 capacitor
VS+	2	O	Positive charge pump output for storage capacitor only
C1-	3	—	Negative lead of C1 capacitor
C2+	4	—	Positive lead of C2 capacitor
C2-	5	—	Negative lead of C2 capacitor
VS-	6	O	Negative charge pump output for storage capacitor only
T2OUT, T1OUT	7, 14	O	RS232 line data output (to remote RS232 system)
R2IN, R1IN	8, 13	I	RS232 line data input (from remote RS232 system)
R2OUT, R1OUT	9, 12	O	Logic data output (to UART)
T2IN, T1IN	10, 11	I	Logic data input (from UART)
GND	15	—	Ground
VCC	16	—	Supply Voltage, Connect to external 5V power supply

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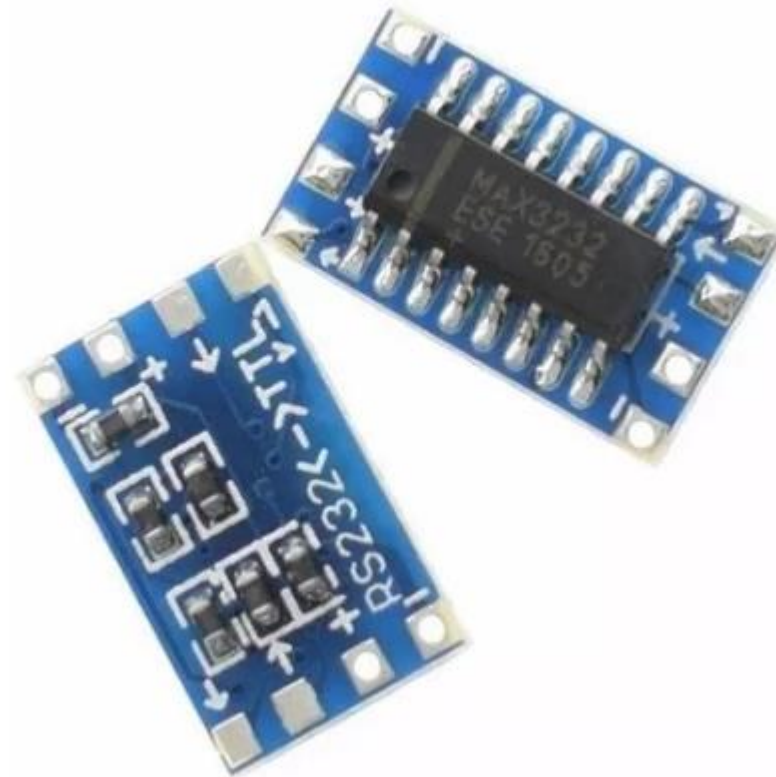
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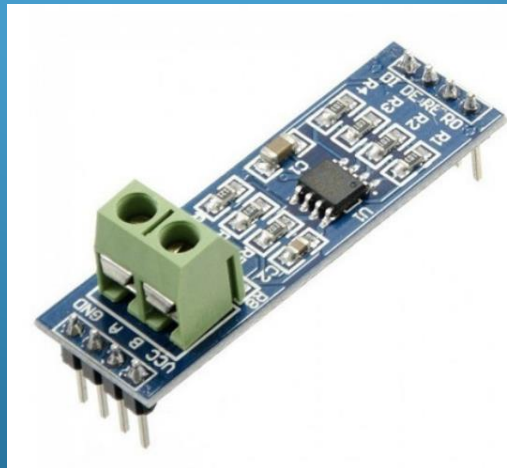
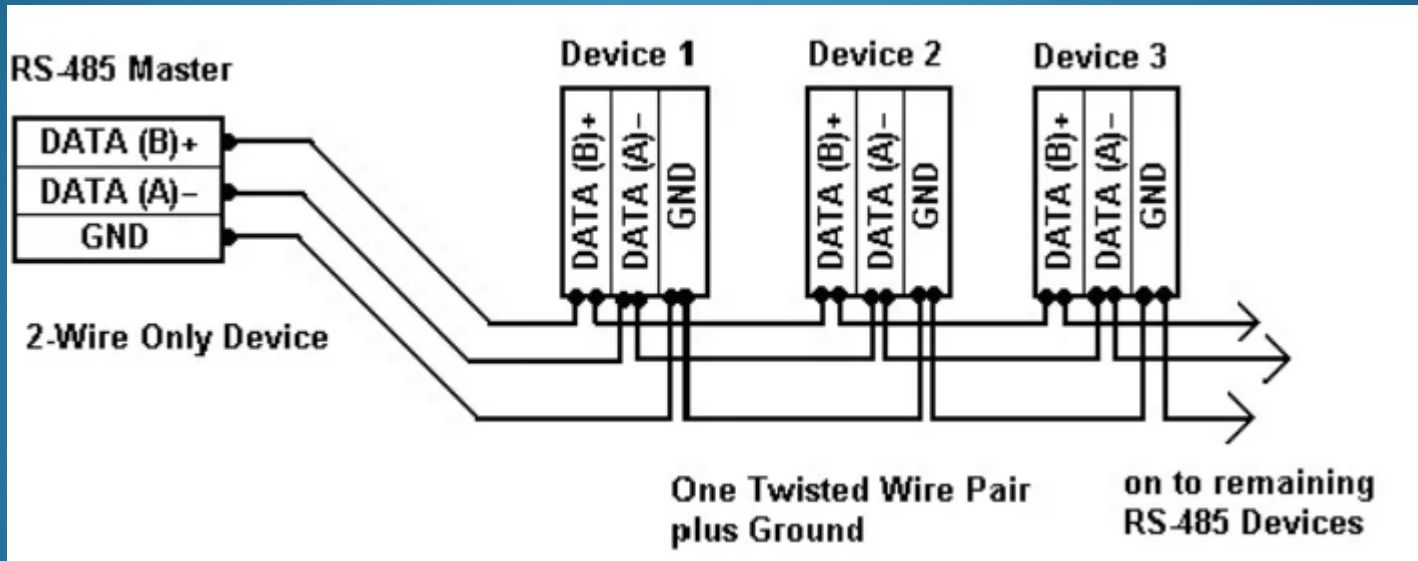
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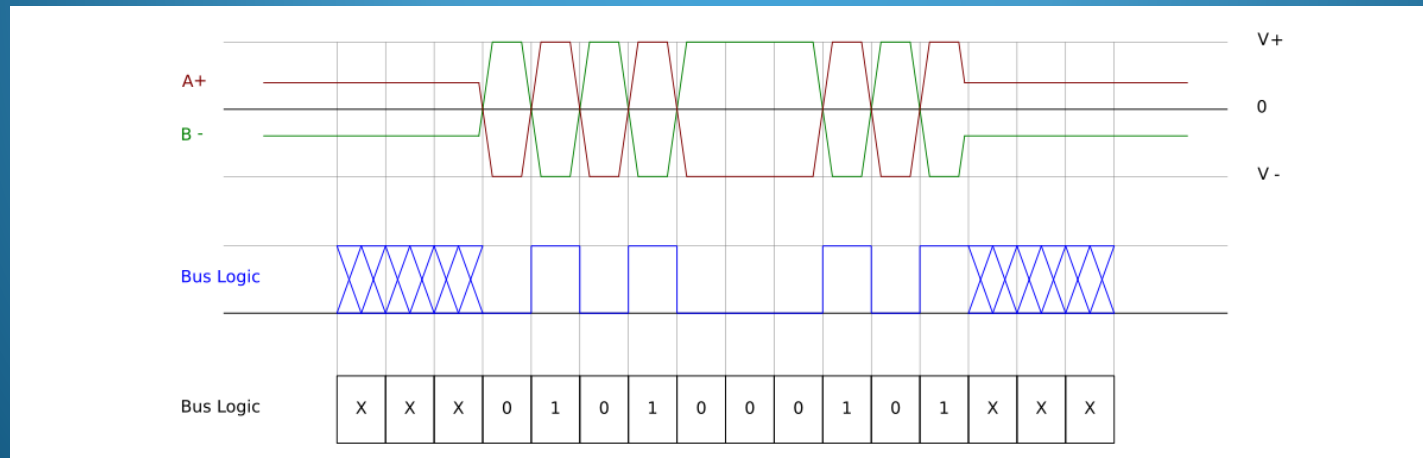
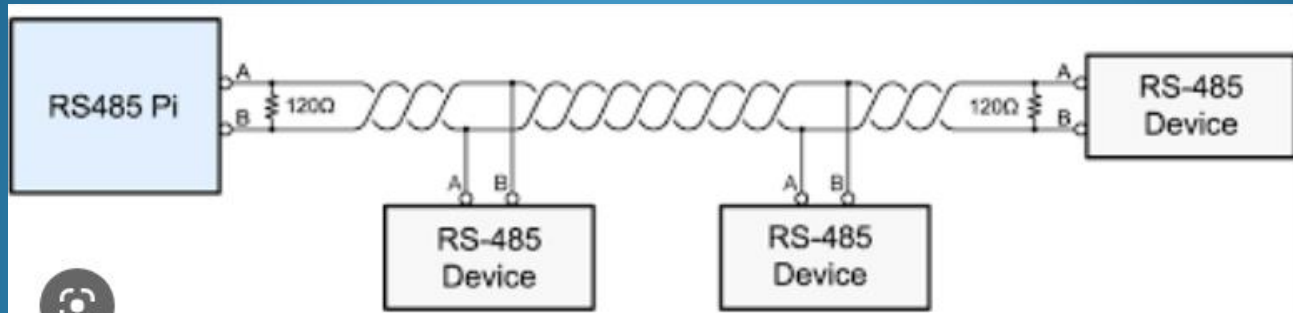
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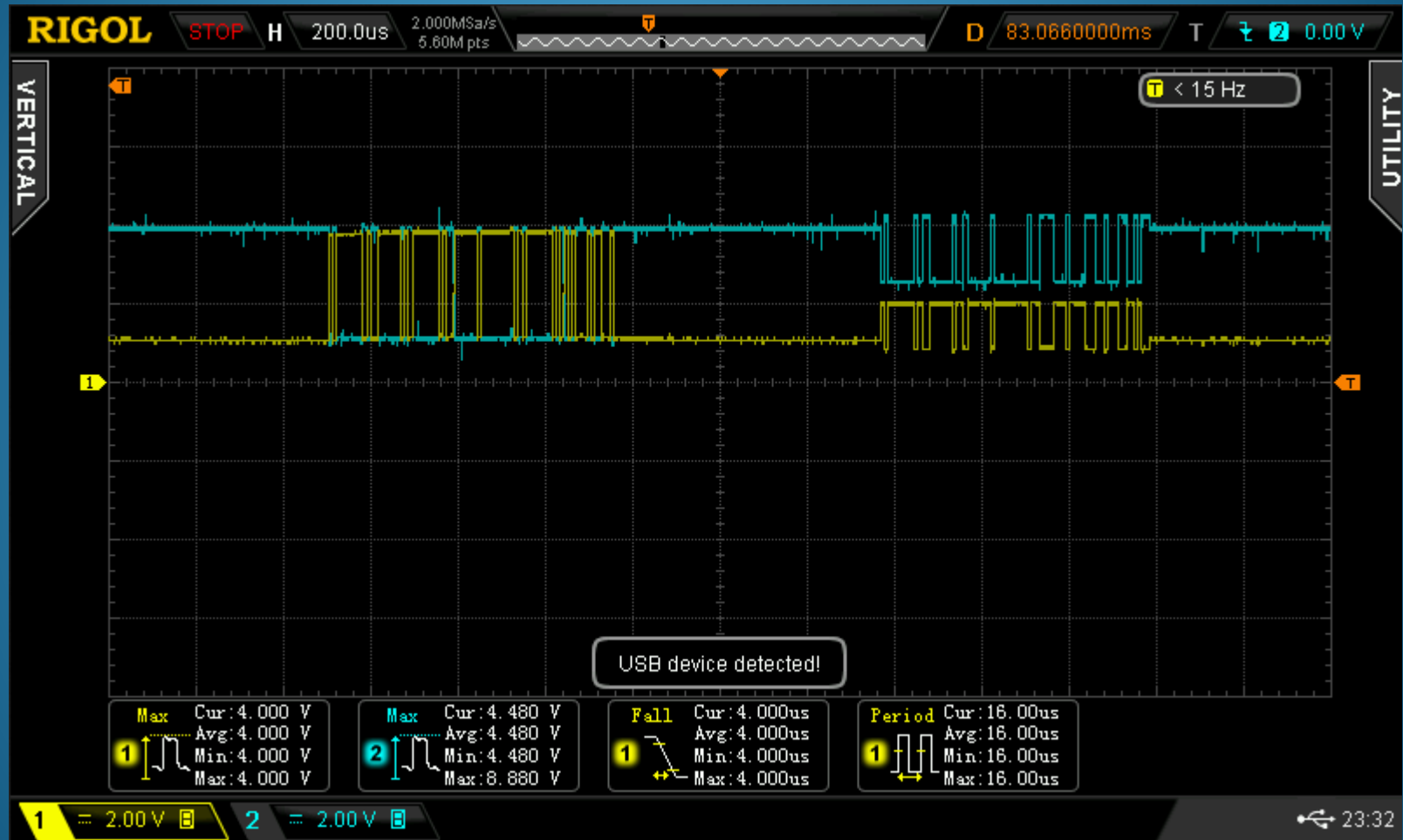
Interfaces serie RS485



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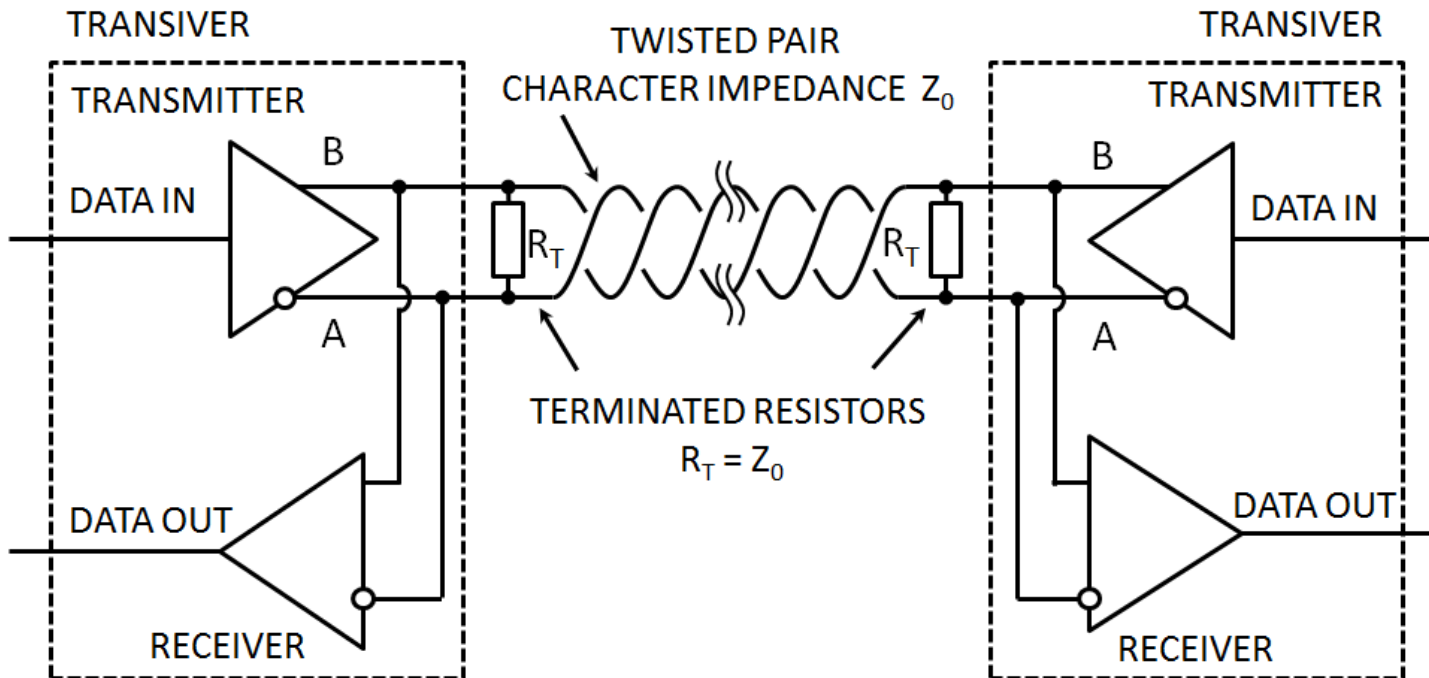


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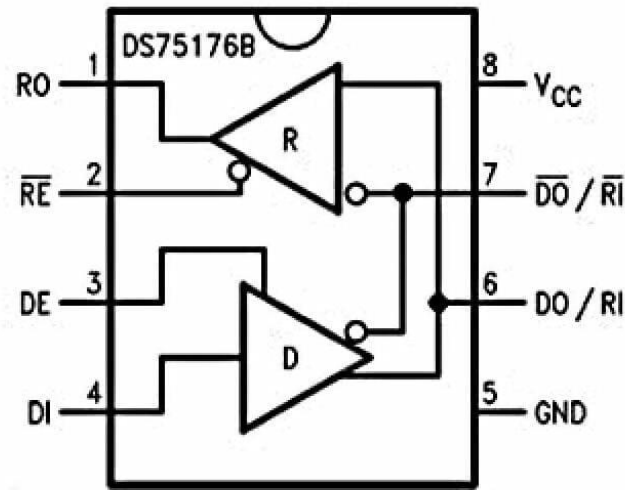
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Simple RS-485 half-duplex connection

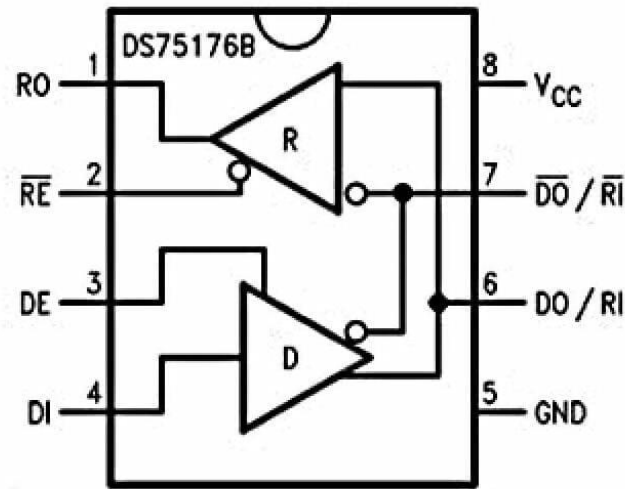


DATA IN	A	B	DATA OUT
0	1	0	0
1	0	1	1

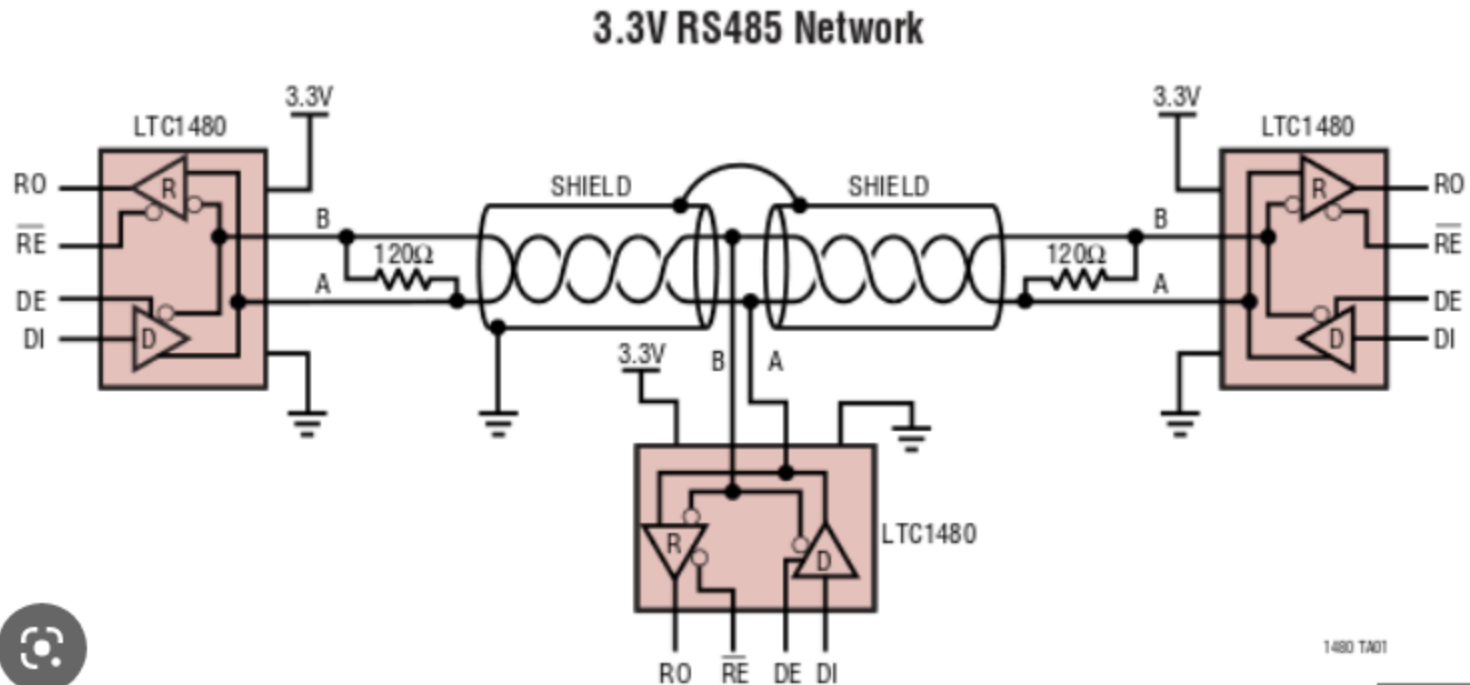
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1480 TA01

615 × 361

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D OR P PACKAGE
(TOP VIEW)

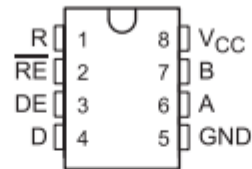
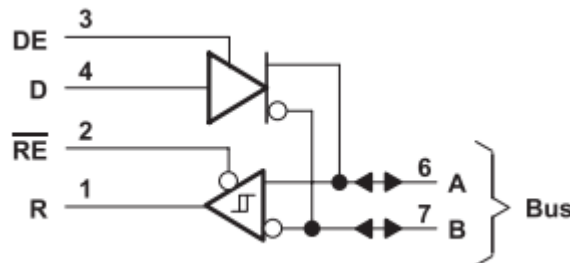


Table 5-1. Pin Functions

PIN		TYPE	DESCRIPTION
NAME	NO.		
R	1	O	Logic Data Output from RS-485 Receiver
$\overline{\text{RE}}$	2	I	Receive Enable (active low)
DE	3	I	Driver Enable (active high)
D	4	I	Logic Data Input to RS-485 Driver
GND	5	—	Device Ground Pin
A	6	I/O	RS-422 or RS-485 Data Line
B	7	I/O	RS-422 or RS-485 Data Line
V _{CC}	8	—	Power Input. Connect to 5-V Power Source.



Interfaces serie RS485

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

		MIN	MAX	UNIT
V _{CC}	Supply Voltage ⁽²⁾		7	V
	Voltage range at any bus terminal	-10	15	V
V _I	Enable input voltage		5.5	V
	Continuous Total power Dissipation	See Dissipation Rating Table		
T _A	Operating free-air temperature range	0	70	°C
T _{stg}	Storage temperature range	65	150	°C

6.2 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

			MIN	TYP	MAX	UNIT
V _{CC}	Supply Voltage		4.75	5	5.25	V
V _I or V _{IC}	Voltage at any buss terminal (separately or common mode)		-7		12	V
V _{IH}	High-level input voltage	D, DE, and RE	2			V
V _{IL}	Low-level input voltage	D, DE, and RE			0.8	V
V _{ID}	Differential input voltage ⁽¹⁾				±12	V
I _{OH}	High-level output current	Driver			-60	mA
		Receiver			-400	µA
I _{OL}	Low-level output current	Driver			60	mA
		Receiver			8	
T _A	Operating free-air temperature		0		70	°C

Interfaces serie RS485

6.5 Electrical Characteristics – Driver

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP ⁽¹⁾	MAX	UNIT
V _{IK}	Input clamp voltage	I _I = -18 mA			-1.5	V
V _{OH}	High-level output voltage	V _{IH} = 2 V, V _{IL} = 0.8 V, I _{OH} = -33 mA		3.7		V
V _{OL}	Low-level output voltage	V _{IH} = 2 V, V _{IL} = 0.8 V, I _{OH} = 33 mA		1.1		V
V _{OD1}	Differential output voltage	I _O = 0			2V _{OD2}	V
V _{OD2}	Differential output voltage	RL = 100 Ω, see Figure 7-1	2	2.7		V
		RL = 54 Ω, see Figure 7-1	1.5	2.4		
Δ V _{OD}	Change in magnitude of differential output voltage ⁽²⁾				±0.2	V
V _{OC}	Common-mode output voltage ⁽³⁾	RL = 54 Ω or 100 Ω, see Figure 7-1			3	V
Δ V _{OC}	Change in magnitude of common-mode output voltage ⁽²⁾				±0.2	V
I _O	Output current	Output disabled ⁽⁴⁾	V _O = 12 V		1	mA
			V _O = -7 V		-0.8	
I _{IH}	High-level input current	V _I = 2.4 V			20	μA
I _{IL}	Low-level input current	V _I = 0.4 V			-400	μA
I _{OS}	Short-circuit output current	V _O = -7 V			-250	mA
		V _O = V _{CC}			250	
		V _O = 12 V			500	
I _{CC}	Supply current (total package)	No load	Outputs enabled	35	50	mA
			Outputs disabled	26	40	

Interfaces serie RS485

6.6 Electrical Characteristics – Receiver

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP ⁽¹⁾	MAX	UNIT
V_{IT+}	Positive-going input threshold voltage	$V_O = 2.7\text{ V}$, $I_O = -0.4\text{ mA}$			0.2	V
V_{IT-}	Negative-going input threshold voltage	$V_O = 0.5\text{ V}$, $I_O = 8\text{ mA}$	-0.2			V
V_{hys}	Input hysteresis voltage ($V_{IT+} - V_{IT-}$)			50		mV
V_{IK}	Enable clamp voltage	$I_I = -18\text{ mA}$			-1.5	V
V_{OH}	High-level output voltage	$V_{ID} = 200\text{ mV}$, $I_{OH} = -400\text{ }\mu\text{A}$ See Figure 7-2	2.7			V
V_{OL}	Low-level output voltage	$V_{ID} = 200\text{ mV}$, $I_{OH} = 8\text{ mA}$ See Figure 7-2			0.45	V
I_{OZ}	High-impedance-state output current	$V_O = 0.4\text{ V to } 2.4\text{ V}$			± 20	μA
I_I	Line input current	Other input = $0\text{ V}^{(2)}$	$V_I = 12\text{ V}$		1	mA
			$V_I = -7\text{ V}$		-0.8	
I_{IH}	High-level enable input current	$V_{IH} = 2.7\text{ V}$			20	μA
I_{IL}	Low-level enable input current	$V_{IL} = 0.4\text{ V}$			-100	μA
r_i	Input resistance		12			k Ω
I_{OS}	Short-circuit output current		-15		-85	mA

Interfaces serie RS485

6.6 Electrical Characteristics – Receiver (continued)

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP ⁽¹⁾	MAX	UNIT
I _{CC}	Supply current (total package)	No load		35	50	mA
				26	40	

(1) All typical values are at V_{CC} = 5 V, T_A = 25°C.

(2) This applies for both power on and power off. Refer to ANSI Standard EIA/TIA-422-B for exact conditions.

6.7 Switching Characteristics – Driver

V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{d(OD)}	Differential-output delay time	R _L = 60 Ω, See Figure 7-3		40	60	ns
t _{i(OD)}	Differential-output transition time			65	95	ns
t _{PZH}	Output enable time to high level	R _L = 110 Ω, See Figure 7-4		55	90	ns
t _{PZL}	Output enable time to low level	R _L = 110 Ω, See Figure 7-5		30	50	ns
t _{PHZ}	Output disable time from high level	R _L = 110 Ω, See Figure 7-4		85	130	ns
t _{PLZ}	Output disable time from low level	R _L = 110 Ω, See Figure 7-5		20	40	ns

6.8 Switching Characteristics – Receiver

V_{CC} = 5 V, C_L = 15 pF, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{PLH}	Propagation delay time, low-to-high-level output	V _{ID} = -1.5 V to 1.5 V, See Figure 7-6		21	35	ns
t _{PHL}	Propagation delay time, high-to-low-level output			23	35	ns
t _{PZH}	Output enable time to high level	See Figure 7-7		10	30	ns
t _{PZL}	Output enable time to low level			12	30	ns
t _{PHZ}	Output disable time from high level	See Figure 7-7		20	35	ns
t _{PLZ}	Output disable time from low level			17	25	ns