V.35 Interface Receiver / Transmitter

GENERAL DESCRIPTION

The V.35 chip set consists of two bipolar chips, one performing a receive function, the other a transmit function according to the specification requirements laid down in Appendix II of the V.35 CCITT Recommendation and Bell 306 modem interface specification.

Typical applications require three transmit and receive pairs to establish the link between distant DTE's at data rates ranging from 48Kbps to 10Mbps. To conserve power (especially in the case of the transmitter, which requires approximately 22mA for each output stage to meet CCITT specifications), power-down functions are included in both devices, allowing any of the three receive/transmit circuits to be disabled. All inputs and outputs are TTL compatible and designed to offer maximum versatility and performance.

Both the transmitter and receiver require termination resistors external to each device, to meet the V.35 specification tolerance.

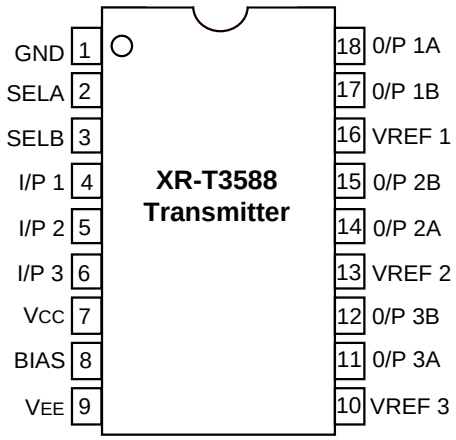
FEATURES

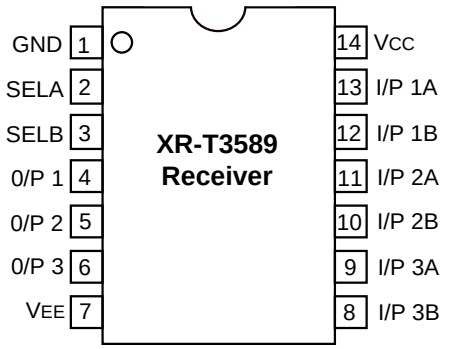
- Compatible with CCITT V.35 and Bell 306 Interface Requirements
- TTL Input Compatibility
- High Common Mode Output Voltage Range
- Excellent Stability over Supply and Temperature Range
- High Speed Operation (up to 10Mbps)
- Individual Receive/Transmit Power-down capability

APPLICATIONS

High Speed Data Transmission Systems
Short Haul Modems
Signal Converters and Adapters
Network and Diagnostic Systems
Matrix Switches
Modem Emulators

PIN DESCRIPTION





ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T3588CN	CDIP	0°C to 70°C
XR-T3588CP	PDIP	0°C to 70°C
XR-T3589CN	CDIP	0°C to 70°C

ABSOLUTE MAXIMUM RATINGS

Supply Voltages	±7V
Storage Temperature	-65°C to +150°C
Power Dissipation	
XR-T3588CN	1000mW
XR-T3589CN	300mW

EXAR Corporation, 48720 Kato Road Fremont, CA. 94538 Phone 510/438-7000 Fax 510/438-7018

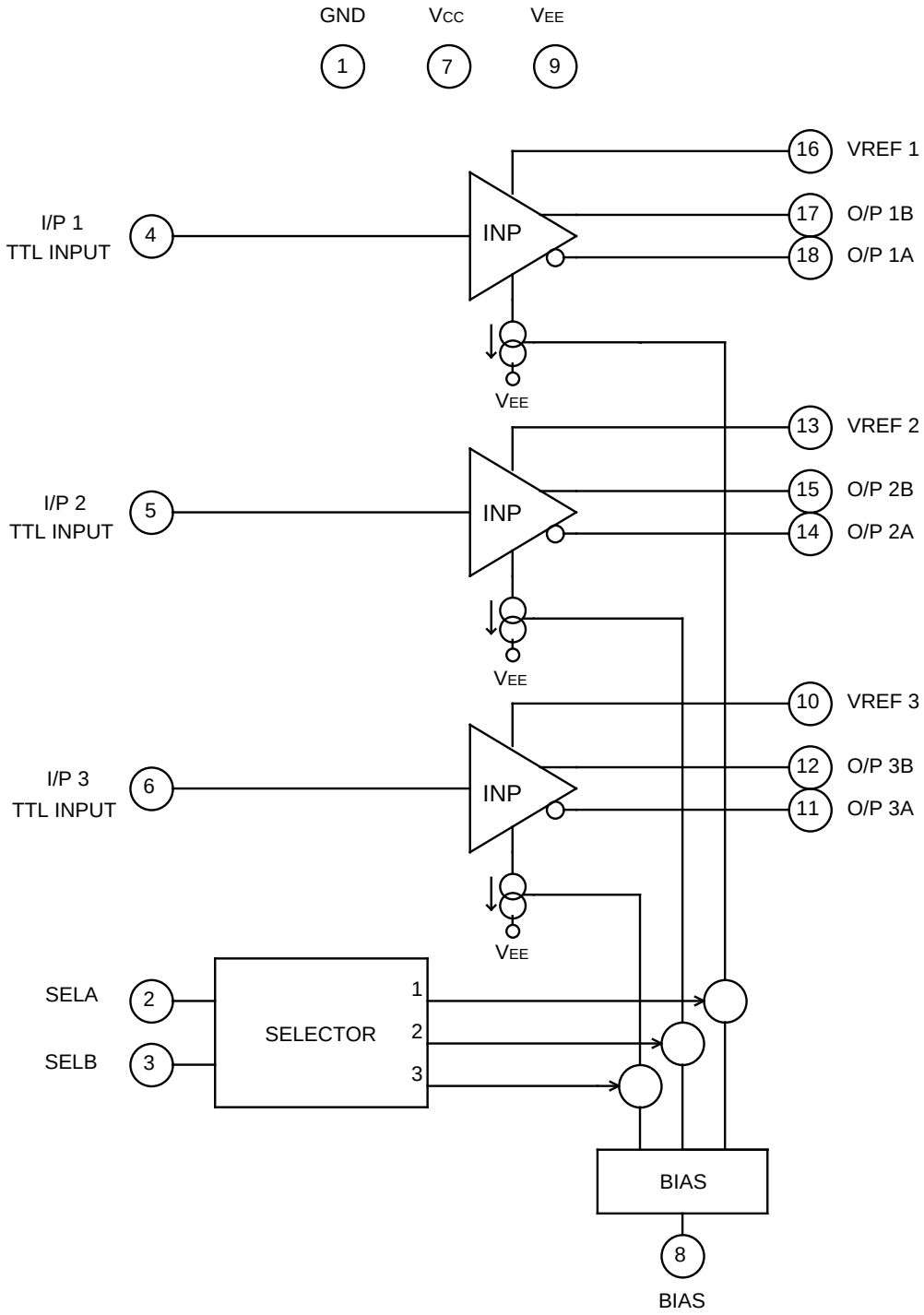


Figure 1. XR-T3588 Block Diagram

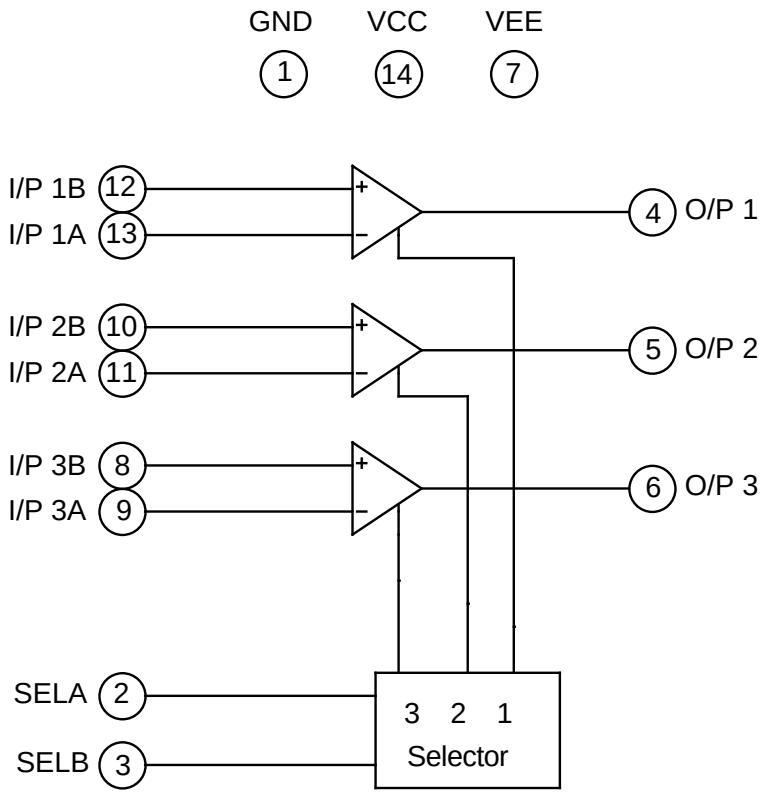


Figure 2. XR-T3589 Block Diagram

PIN DESCRIPTIONS for T3588

PIN #	SYMBOL	TYPE	DESCRIPTION
1	GND	-	**Ground (0V).**
2	SELA	I	**Channel enable select A input.** TTL compatible input used in conjunction with SELB to power down individual transmitter channels. (see table 1).
3	SELB	I	**Channel enable select B input.** TTL compatible input used in conjunction with SELA to power down individual transmitter channels (see table 1).
4	I/P1	I	**Channel 1 input.** TTL compatible.
5	I/P2	I	**Channel 2 input.** TTL compatible.
6	I/P3	I	**Channel 3 input**. TTL compatible.
7	V_{CC}	-	**Positive Supply (5V).**
8	BIAS	I	**Bias current input.** DC level 1.1V nominal. Connect external resistor from pin to ground to define transmitter output current levels (R_{bias} 3.9k for Iout=22mA).
9	V_{EE}	-	**Negative Supply (-5V).**
10	VREF3	O	**Channel 3 Voltage regulator.** Provides 3.3V regulated supply for connection of channel 3 transmit termination network (see figure 6). If the driver is disabled, the voltage output at this pin will be V_{CC} - 0.7V.
11	O/P3A	O	**Channel 3 differential output A.** Open collector current output. Current sink capability 22mA nominal (defined by R_{bias}). When terminated with network to VREF3 provides an output voltage with inverse phase to I/P3. DC level with TX and RX termination +/-0.275V nominal.
12	O/P3B	O	**Channel 3 differential output B**. Open collector current output. Current sink capability 22mA nominal (defined by R_{bias}). When terminated with network to VREF3 provides an output voltage in phase with I/P3. DC level with TX and RX termination +/-0.275V nominal.
13	VREF2	O	**Channel 2 Voltage regulator.** Provides 3.3V regulated supply for connection of channel 2 transmit termination network (see figure 6). If the driver is disabled, the voltage output at this pin will be V_{CC} - 0.7V.
14	O/P2A	O	**Channel 2 differential output A.** Open collector current output. Current sink capability 22mA nominal (defined by R_{bias}). When terminated with network to VREF2 provides an output voltage with inverse phase to I/P2. DC level with TX and RX termination +/-0.275V nominal.

PIN DESCRIPTIONS for T3588 (cont.)

PIN #	SYMBOL	TYPE	DESCRIPTION
15	O/P2B	O	**Channel 2 differential output B.** Open collector current output. Current sink capability 22mA nominal (defined by R_{bias}). When terminated with network to VREF2 provides an output voltage in phase with I/P2. DC level with TX and RX termination +/-0.275V nominal.
16	VREF1	O	**Channel 1 Voltage regulator.** Provides 3.3V regulated supply for connection of channel 1 transmit termination network (see figure 6). If the driver is disabled, the voltage output at this pin will be V_{CC} - 0.7V.
17	O/P1B	O	**Channel 1 differential output B.** Open collector current output. Current sink capability 22mA nominal (defined by R_{bias}). When terminated with network to VREF1 provides an output voltage in phase with I/P2. DC level with TX and RX termination +/-0.275V nominal.
18	O/P1A	O	**Channel 1 differential output A.** Open collector current output. Current sink capability 22mA nominal (defined by R_{bias}). When terminated with network to VREF2 provides an output voltage with inverse phase to I/P1. DC level with TX and RX termination +/-0.275V nominal.

PIN DESCRIPTIONS for T3589

PIN #	SYMBOL	TYPE	DESCRIPTION
1	GND	-	**Ground (0V).**
2	SELA	I	**Channel enable select A input**. TTL compatible input used in conjunction with SELB to power down individual receiver channels. (see table 2).
3	SELB	I	**Channel enable select B input**. TTL compatible input used in conjunction with SELA to power down individual receiver channels (see table 2).
4	O/P1	O	**Channel 1 output**. TTL compatible.
5	O/P2	O	**Channel 2 output.** TTL compatible.
6	O/P3	O	**Channel 3 output.** TTL compatible.
7	V_{EE}	-	**Negative Supply (-5V).**
8	I/P3B	I	**Channel 3 differential input B**. Rin 4kΩ nominal. Should be terminated with an external network to GND (see figure 8).
9	I/P3A	I	**Channel 3 differential input A.** Rin 4kΩ nominal. Should be terminated with an external network to GND (see figure 8).
10	I/P2B	I	**Channel 2 differential input B**. Rin 4kΩ nominal. Should be terminated with an external network to GND (see figure 8).
11	I/P2A	I	**Channel 2 differential input A**. Rin 4kΩ nominal. Should be terminated with an external network to GND (see figure 8).
12	I/P1B	I	**Channel 1 differential input B**. Rin 4kΩ nominal. Should be terminated with an external network to GND (see figure 8).
13	I/P1A	I	**Channel 1 differential input A.** Rin 4kΩ nominal. Should be terminated with an external network to GND (see figure 8).
14	V_{CC}	-	**Positive Supply (5V).**

TRANSMITTER: XR-T3588
SYSTEM DESCRIPTION

The function of the transmitter is to take a TTL input signal at a maximum bit rate of 10Mbps and output a balanced differential signal with a peak amplitude of 0.55V and a maximum DC offset of 0.6V. An internal buffer provides the regulated output voltage to set the mean level of the transmitters to less than 0.6V. Figure 5 shows a simplified circuit for the output stage.

To meet the pulse shape and offset requirements laid down in the V.35 specification, the transmitter employs an internal temperature compensated voltage generator to provide reference voltages for both offset control and output current generation. Load resistors for the output stage, which provide the required source impedance for the transmitter, are external to the IC and are required to meet the V.35 specified tolerance.

To generate well defined output pulses, device current is set using an external resistor, which should be of the same type as the transmitter load resistors. Each device contains three independent transmit circuits.

Individual transmitters may be shut down to achieve power savings for applications not requiring three channels. Two TTL compatible inputs provide four combinations of transmitter configurations, as defined in table 1. If either of the select pins is left open a high state is adopted, hence with no inputs applied, all channels are powered up. However it is recommended to tie all select inputs to either GND or V_{CC}.

Transmitter		SEL A	SEL B
1-2-3	ON	HIGH	HIGH
1-2	ON	HIGH	LOW
1	ON	LOW	HIGH
ALL	OFF	LOW	LOW

TABLE 1. TRANSMITTER SELECTORS

XR-T3588 DC ELECTRICAL CHARACTERISTICS

Test Conditions: V_{CC} = 5V ± 5%, V_{EE} = -5V ± 5%, T_A = 0°C to 70°C

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
V_{CC}	Positive Supply Voltage	4.75	5	5.25	V	
V_{EE}	Negative Supply Voltage	-4.75	-5	-5.25	V	
I_{CC}	Input Current		86	124	mA	See Note 1
I_{EE}	Input Current	-132	-92		mA	See Note 1
I_{PCC}	Power Down ICC	0.2		10.2	mA	See Note 2
I_{PEE}	Power Down IEE	-1.0		-14.0	mA	See Note 2
V_{DIH}	High Level Input Voltage	2		VCC	V	Data Inputs
V_{DIL}	Low Level Input Voltage	0		0.8	V	Data Inputs
I_{DIH}	Input Current High			1.0	µA	Data Inputs
I_{DIL}	Input Current Low	-2.1			mA	Data Inputs
V_{SIH}	Selector High Level Voltage	2		VCC	V	
V_{SIL}	Selector Low Level Voltage	0		0.6	V	
I_{SIL}	Selector Input Current Low	-0.6			mA	
I_{SIH}	Selector Input Current High			50	µA	
V_{OL}	Output Low Voltage	-0.91			V	See Note 3
V_{OH}	Output High Voltage			0.85	V	See Note 3
ZS	Source Impedance	90	100	110	Ohm	Per CCITT V.35, see note 4
R_{GND}	Resistance to Ground	135	150	165	Ohm	Per CCITT V.35, see note 4
IODIFF	Output Current Differential	20.2	22.0	23.8	mA	With 3.9K bias resistor
V_{REF}	Transmitter Reference Voltage	3.0	3.3	3.6	V	Voltage Output

Note 1: *With external transmit network (figure 6) connected to each transmitter output and select A, select B both high.*
Note 2: *All transmitter outputs open-circuit and select A, select B both low.*
Note 3: *With external transmit network terminated with 100 Ohm (figure 7).*
Note 4: *Differential impedance between O/P A and O/P B. external transmit network (figure 6) connected to transmitter output.*
Note 5: *O/P A's and O/P B's connected together, resistance measured to ground, external transmit network (figure 6) present.*

RECEIVER: XR-T3589
SYSTEM DESCRIPTION

The XR-T3589 Line Receiver contains three identical receive circuits to complement the XR-T3588 Line Transmitter. Received differential signals are converted into a single TTL compatible output. The input stage is designed to meet the full V.35 noise and common mode input specification.

Individual receivers may be shut down to achieve power savings for applications not requiring three channels. Two TTL compatible inputs provide four combinations of transmitter configurations, as defined in table 2. If either of the select pins is left open a high state is adopted, hence with no inputs applied, all channels are powered up. However it is recommended to tie all select inputs to either GND or V_{CC}.

RECEIVER		SEL A	SEL B
1-2-3	ON	HIGH	HIGH
1-2	ON	HIGH	LOW
1	ON	LOW	HIGH
ALL	OFF	LOW	LOW

TABLE 2. Receiver Selectors

XR-T3589 DC ELECTRICAL CHARACTERISTICS
Test Conditions: V_{CC} = 5V ± 5%, V_{EE} = -5V ± 5%, T_A = 0°C to 70°C

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
V_{CC}	Supply Voltage	4.75	5	5.25	V	
V_{EE}	Supply Voltage	-5.25	-5	-4.75	V	
I_{CC}	Input Current		40	60	mA	Select A, Select B, both high
I_{EE}	Input Current		7	9	mA	Select A, Select B, both high
I_{OH}	Output High Level Current	-1.6			µA	VOH ≥ 2.4V
I_{OL}	Output Low Level Current			40	mA	VOL < 0.4 V
V_{OH}	High Level Output	2.4			V	at IOH < 40µA
V_{OL}	Low Level Output			0.4	V	at IOL < 1.6mA
Vin	Input Sensitivity	400			mV	Differential, see note 2
Z_{INO}	Input Impedance	8			kOhm	Differential, see note 2
Z_{INT}	Input Impedance	90	100	110	Ohm	per CCITT V.35, see note 1,2
R_{GND}	Resistance to GND	135	150	165	Ohm	per CCITT V.35, see note 1,2
V_{SIH}	Select High Level Voltage	2		Vcc	V	
V_{SIL}	Select Low Level Voltage			0.8	V	
I_{PCC}	Power Down I_{CC} Current		1.1		mA	Select A, Select B, both low
I_{PEE}	Power Down I_{EE} Current	-0.3			mA	

Note 1: *I/P terminated to circuit 102 (see figure 8)*
Note 2: *Pins 8-9, 10-11, 12-13*

XR-T3588 AC CHARACTERISTICS

Test Conditions: V_{CC} = 5V ± 5%, V_{EE} = -5V ± 5%, T_A = 0°C to 70°C (see figure 3)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
t_{PLHT}	Input to Output		25	50	nsec	see note 1
t_{PHLT}	Input to Output		25	50	nsec	see note 1
t_{RT}	TX Rise Time		10	20	nsec	see note 1
t_{FT}	TX Fall Time		10	20	nsec	see note 1

Note 1: *O/P terminated with external transmit network terminated with 100 Ohms (See Figure 7)*

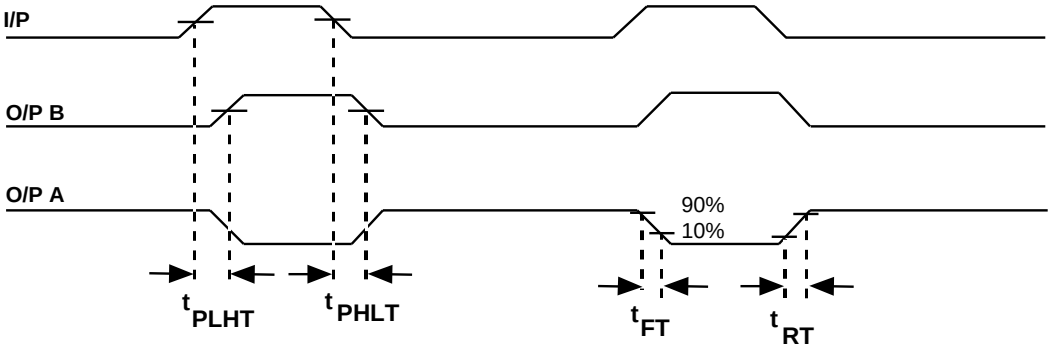


Figure 3. Transmitter Waveforms

XR-T3589 AC CHARACTERISTICS

Test Conditions: V_{CC} = 5V ± 5%, V_{EE} = -5V ± 5%, T_A = 0°C to 70°C (see figure 4)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
t_{PLHR}	Input to Output		50	70	nsec	
t_{PHLR}	Input to Output		50	70	nsec	
t_{RR}	RX Rise Time		18	40	nsec	
t_{FR}	RX Fall Time		12	30	nsec	

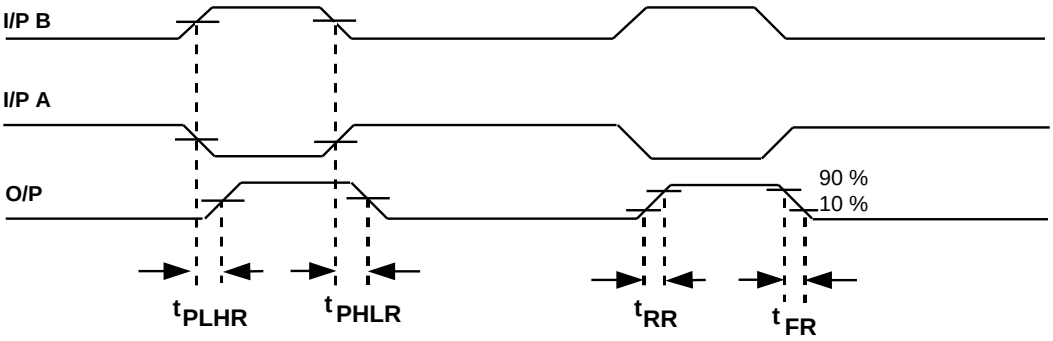


Figure 4. Receiver Waveforms

TYPICAL APPLICATIONS

Figure 9 shows a schematic for a typical application of the XR-T3588/T3589. In this application the termination resistor network is fed from the chip on-board regulator. The regulator provides a voltage of 3.3V.

The major issue is the power dissipation of the XR-T3588. Following is a discussion of the power that is dissipated by the XR-T3588 when all three drivers are active simultaneously. The power used by the XR-T3588 is given by;

$$Pd = (V_{CC} \cdot I_{CC} + V_{EE} \cdot I_{EE}) - 3 \cdot (R_{term} \cdot (I_{term})^2)$$

Where: V_{CC}, I_{CC}, V_{EE} and I_{EE} are the positive and negative supply voltages and currents, whose values may be found in the typical column of the DC Characteristics,

R_{term} is the equivalent impedance of the termination network,

I_{term} is the current flow through the termination network.

In the case of the three drivers enabled and terminated, the typical power dissipation is;

$$Pd = (5 \cdot 0.086 + (5 \cdot 0.092)) - 3 \cdot (150 \cdot (0.022)^2) = 672.2mW$$

The junction temperature of the part is given by;

$$T_{junction} = T_{ambient} + (\theta_{JA} \cdot Pd)$$

where: $T_{junction}$ is junction temperature,

$T_{ambient}$ is ambient temperature,

θ_{JA} is package thermal impedance.

For reliable operation, the absolute maximum junction temperature must be maintained below 150°C. With a θJA for the ceramic package of 80°C/W, and a maximum ambient temperature of 70°C the junction temperature is;

$$T_{junction} = 70 + 80 \cdot 0.672 = 134°C$$

If the device is used in an enclosure without forced cooling where the ambient temperature could approach or exceed 70°C, the power dissipation of the part should be reduced for improved reliability.

Figure 10 shows an implementation using an external reference voltage made with two resistors of values 180 Ohm and 360 Ohm. This implementation offers the advantage of eliminating the feeding current to the termination network from the on chip reference, thereby reducing the dissipation in the XR-T3588.

The formula to calculate the on chip power dissipation is now;

$$Pd = (V_{CC} \cdot I_{CC} + V_{EE} \cdot I_{EE}) - 3 \cdot ((V_{CC} - 3.3) \cdot I_{term} + R_{term} \cdot (I_{term})^2)$$

Where the term "$3 \cdot (V_{CC} - 3.3) \cdot (Iterm)$" is the power previously dissipated in the XR-T3588 internal voltage regulator.

The revised value of power dissipation is;

$$Pd = (5 \cdot 0.086) + (5 \cdot 0.092) - 3 \cdot ((5 - 3.3) \cdot 0.022 + 150 \cdot (0.022)^2) = 560mW$$

The total on chip power saving is;
$3 \cdot (5 - 3.3) \cdot 0.022$, i.e. 112.2 mW.

Figure 11 shows the demo board schematic.

To obtain a demo board, call your local representative.

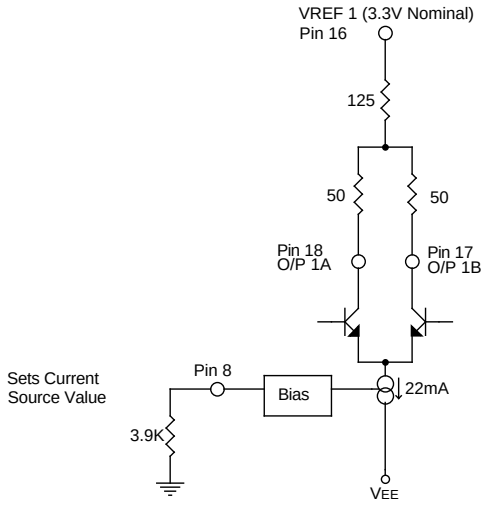


Figure 5. XR-T3588 Output Stage Simplified Circuit

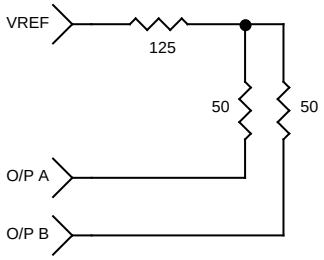


Figure 6. External Transmit Network

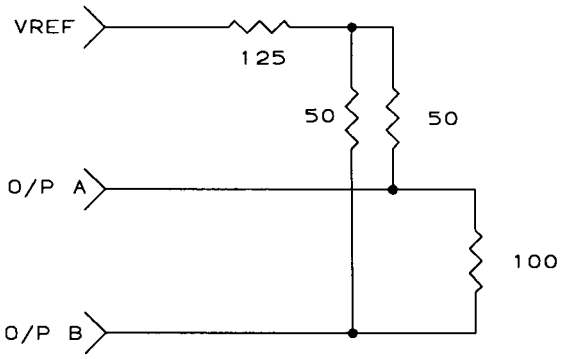


Figure 7. External Transmit Network Terminated with 100 Ohms

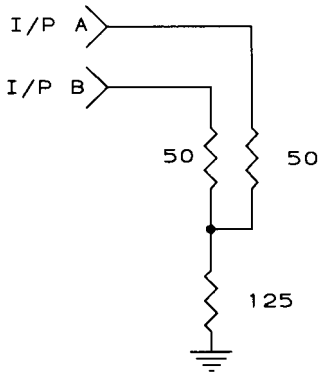
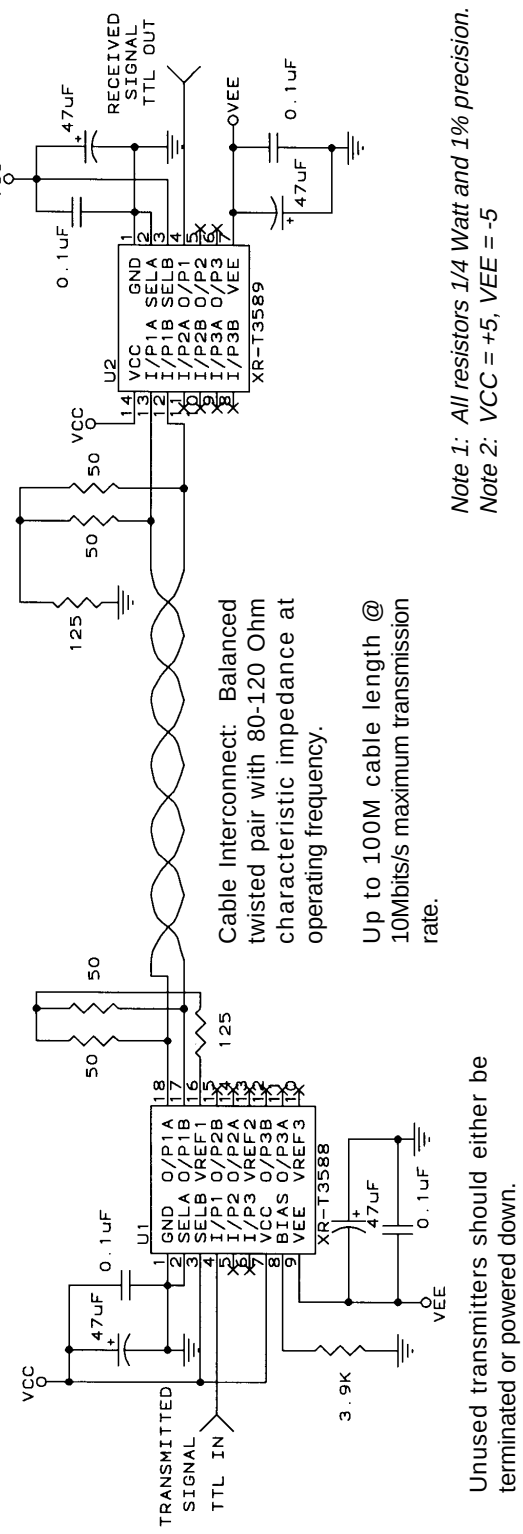


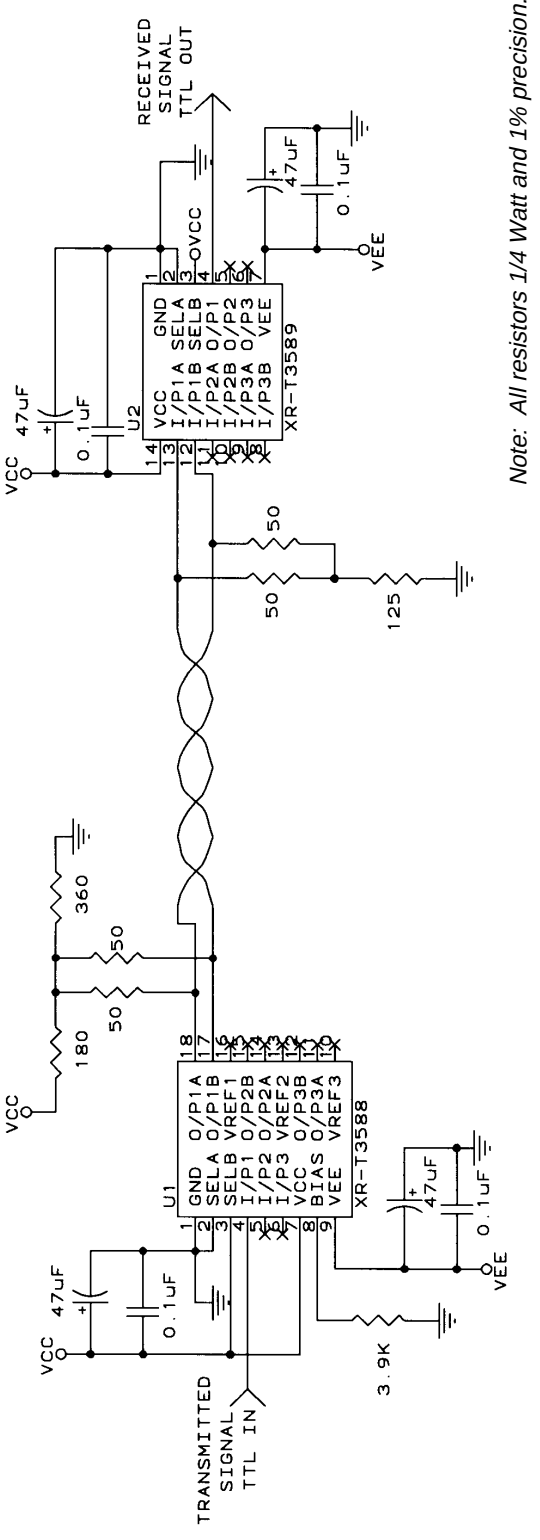
Figure 8. CCITT Circuit 102 Input Termination



Note 1: All resistors 1/4 Watt and 1% precision.
Note 2: VCC = +5, VEE = -5

Figure 9. Application Circuit XR-T3588, XR-T3589

Unused transmitters should either be terminated or powered down.



Note: All resistors 1/4 Watt and 1% precision.

Figure 10. Typical Low Power Dissipation

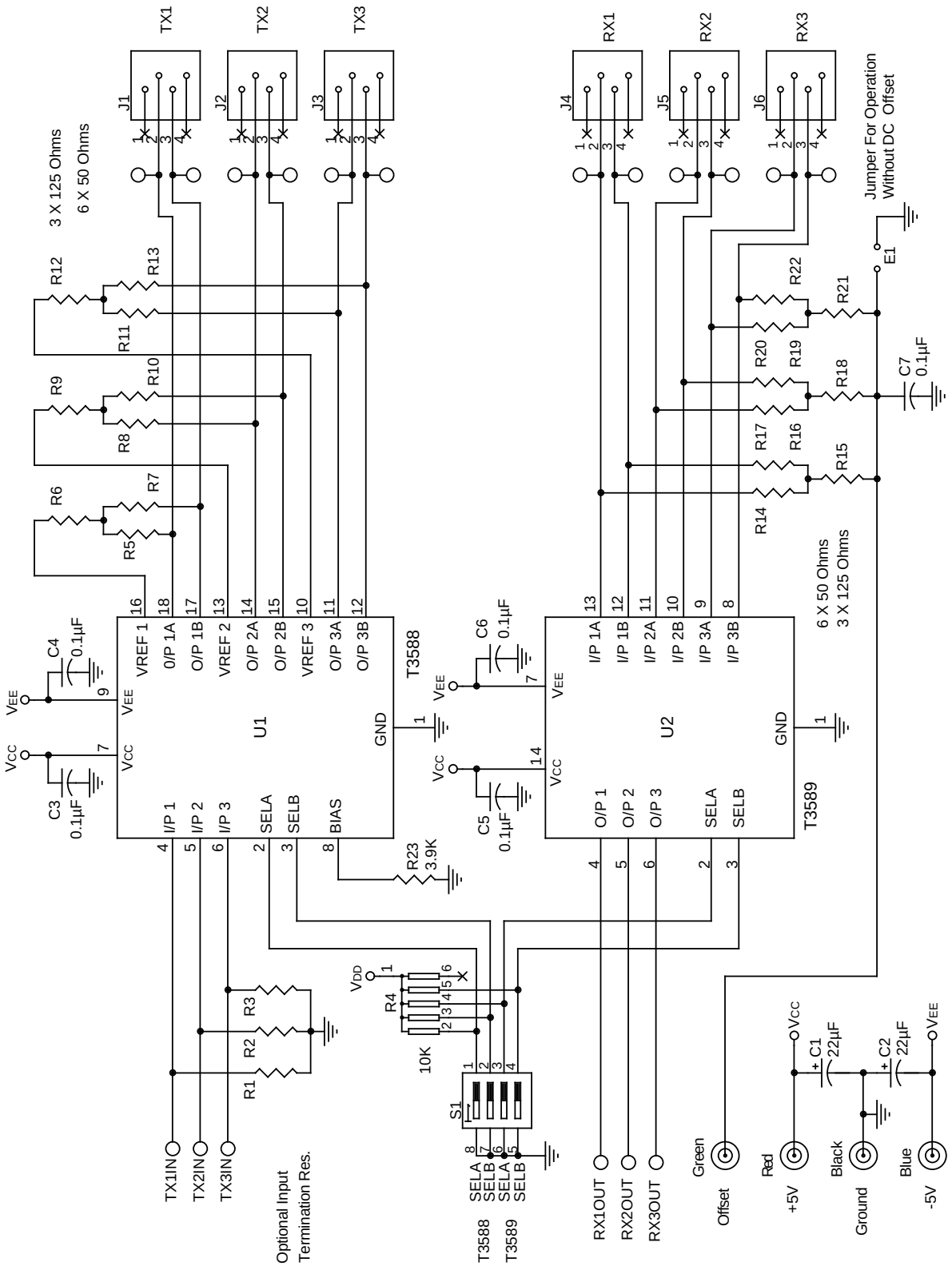


Figure 11. Demo Board Schematic