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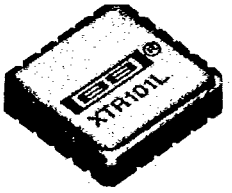
BURR-BROWN®



XTR101L

LCC Precision, Low Drift 4mA to 20mA TWO-WIRE TRANSMITTER

FEATURES

- INSTRUMENTATION AMPLIFIER INPUT
  - Low Offset Voltage, 30µV max
  - Low Voltage Drift, 0.75µV/°C max
  - Low Nonlinearity, 0.01% max
- TRUE TWO-WIRE OPERATION
  - Power and Signal on One Wire Pair
  - Current Mode Signal Transmission
  - High Noise Immunity
- DUAL MATCHED CURRENT SOURCES
- WIDE SUPPLY RANGE, 11.6V TO 40V
- –40°C TO +85°C SPECIFICATION RANGE
- HERMETIC 20-PIN LEADLESS CHIP CARRIER PACKAGE

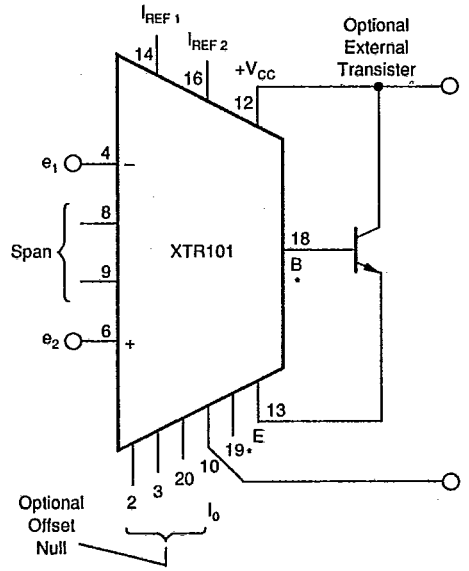
APPLICATIONS

- INDUSTRIAL PROCESS CONTROL
  - Pressure Transmitters
  - Temperature Transmitters
  - Millivolt Transmitters
- RESISTANCE BRIDGE INPUTS
- THERMOCOUPLE INPUTS
- RTD INPUTS
- CURRENT SHUNT (mV) INPUTS
- PRECISION DUAL CURRENT SOURCES
- AUTOMATED MANUFACTURING
- POWER PLANT/ENERGY SYSTEM MONITORING

DESCRIPTION

The XTR101L is a microcircuit, 4mA to 20mA, two-wire transmitter containing a high accuracy instrumentation amplifier (IA), a voltage-controlled output current source, and dual-matched precision current reference. This combination is ideally suited for remote signal conditioning of a wide variety of transducers such a thermocouples, RTDs, thermistors, and strain gauge bridges. State-of-the-art design and laser-trimming, wide temperature range operation and small size make it very suitable for industrial process control applications. In addition the optional external transistor allows even higher precision.

The two-wire transmitter allows signal and power to be supplied on a single wide-pair by modulating the power supply current with the input signal source. The transmitter is immune to voltage drops from longs runs and noise from motors, relays, actuators, switches, transformers, and industrial equipment. It can be used by OEMs producing transmitter modules or by data acquisition system manufacturers. Also, the XTR101L is generally very useful for low-noise, current-mode signal transmission.



*Pins 18 and 19 are used for optional BW control

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SPECIFICATIONS

ELECTRICAL

At T_A = +25°C, $+V_{CC}$ = 24VDC, R_L = 100Ω with external transistor connected unless otherwise notes.

PARAMETER	CONDITIONS/DESIGNATION	XTR101AL MIN	XTR101AL TYP	XTR101AL MAX	XTR101BL MIN	XTR101BL TYP	XTR101BL MAX	UNITS
OUTPUT AND LOAD CHARACTERISTICS								
Current	Linear Operating Region	4		20	*		*	mA
	Derated Performance	3.8		22	*		*	mA
Current Limit			28	38		*	*	mA
Offset Current Error	I_{OS}, I_O = 4mA		±3.9	±10		±2.5	±6	µA
vs Temperature	$\Delta I_{OS}/\Delta T$		±10.5	±20		±8	±15	ppm, FS/°C
Full Scale Output Current Error	Full Scale = 20mA		±20	±40		±15	±30	µA
Power Supply Rejection		110	125		*	*		dB
Power Supply Voltage	V_{CC}, Pins 10 and 12, Compliance[1]	+11.6		+40	*		*	VDC
Load Resistance	At V_{CC} = +24V, I_O = 20mA			600			*	Ω
	At V_{CC} = +40V, I_O = 20mA			1400			*	Ω
SPAN								
Output Current Equation	R_S in Ω, e_1 and e_2 in V		$I_O = 4mA + [0.016\mho + (40/R_S)](e_2 - e_1)$					
Span Equation	R_S in Ω		$S = [0.016\mho + (40/R_S)]$					A/V
vs Temperature	Excluding TCR of R_S		±30	±100		*	*	ppm/°C
Untrimmed Error[2]	ε_{SPAN}	–5	–2.5	0	*	*	*	%
Nonlinearity	$\varepsilon_{NONLINEARITY}$			0.01			*	%
Hysteresis			0			*		%
Dead Band			0			*		%
INPUT CHARACTERISTICS								
Impedance: Differential			0.4 || 3			*		GΩ || pF
Common-Mode			10 || 3			*		GΩ || pF
Voltage Range, Full Scale	$\Delta e = (e_2 - e_1)$[3]	0		1	*		*	V
Offset Voltage	V_{OS}		±30	±60		±20	±30	µV
vs Temperature	$\Delta V_{OS}/\Delta T$		±0.75	±1.5		±0.35	±0.75	µV/°C
Bias Current	I_S		60	150		*	*	nA
vs Temperature	$\Delta I_S/\Delta T$		0.30	1		*	*	nA/°C
Offset Current	I_{OSI}		10	±30		*	±20	nA
vs Temperature	$\Delta I_{OSI}/\Delta T$		0.1	0.3		*	*	nA/°C
Common-Mode Rejection[4]	DC	90	100		*	*		dB
Common-Mode Range	e_1 and e_2 with Respect to Pin 10	4		6	*		*	V
CURRENT SOURCES								
Magnitude			1			*		mA
Accuracy	V_{CC} = 24V, $V_{PIN12} - V_{PIN\ 14,\ 16}$ = 19V, R_2 = 5kΩ		±0.06	±0.17		±0.025	±0.075	%
vs Temperature			±50	±80		±30	±50	ppm/°C
vs V_{CC}			±3			*		ppm/V
vs Time			±8			*		ppm/month
Compliance Voltage	With Respect to Pin 10	0		V_{CC} – 3.5				V
Ratio Match	Tracking							
Accuracy	$1 - I_{REF\ 1}/I_{REF\ 2}$		±0.014	±0.06		±0.009	±0.04	%
vs Temperature				±15			10	ppm/°C
vs V_{CC}			±10			*		ppm/V
vs Time			±1			*		ppm/month
Output Impedance		10	20		*	*		MΩ
TEMPERATURE RANGE								
Specification		–40		+85	*		*	°C
Operating		–55		+125	*		*	°C
Storage		–55		+165	*		*	°C

*Same as XTR101AL.

NOTES: (1) See Typical Performance Curves. (2) Span error shown is untrimmed and may be adjusted to zero. (3) e_1 and e_2 are signals on the –IN and +IN terminals with respect to the output, pin 10. While the maximum permissible Δe is 1V, it is primarily intended for much lower input signal levels, e.g., 50mV or 10mV full scale for the XTR101A and XTR101B grades respectively. 2mV FS is also possible with the B grade, but accuracy will degrade due to possible errors in the low value span resistance and very high amplification of offset, drift, and noise. (4) Offset voltage is trimmed with the application of a 5V common-mode voltage. Thus the associated common-mode error is removed.

ABSOLUTE MAXIMUM RATINGS

Power Supply, $+V_{CC}$	40V
Input Voltage, e_1 or e_2	≥ V_{OUT}, ≤ $+V_{CC}$
Storage Temperature Range, Ceramic	–55°C to +165°C
Output Short-Circuit Duration	Continuous $+V_{CC}$ to I_{OUT}
Junction Temperature	+165°C

ORDERING INFORMATION

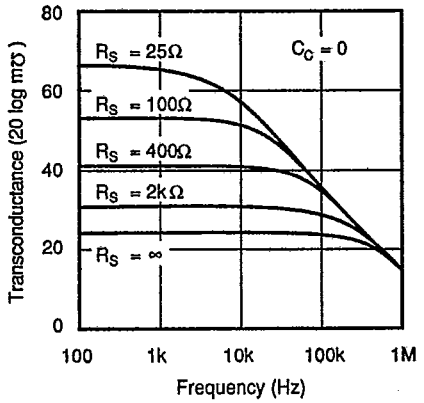
XTR101 X L

- Basic Model Number
- Performance Grade Code
  - A, B: –40°C to +85°C
- Package Code
  - L: 20-Pin Leadless Chip Carrier

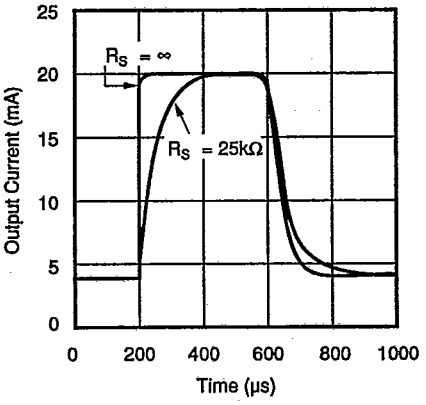
TYPICAL PERFORMANCE CURVES

T_A = 25°C, $\pm V_{CC}$ = 24VDC unless otherwise stated.

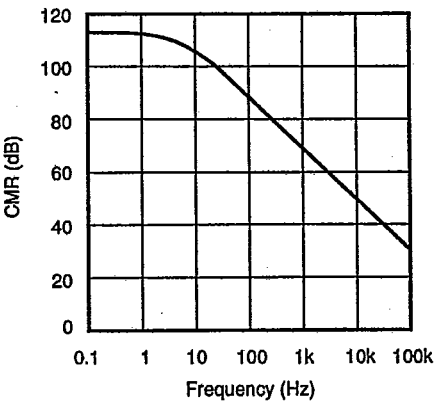
SPAN vs FREQUENCY



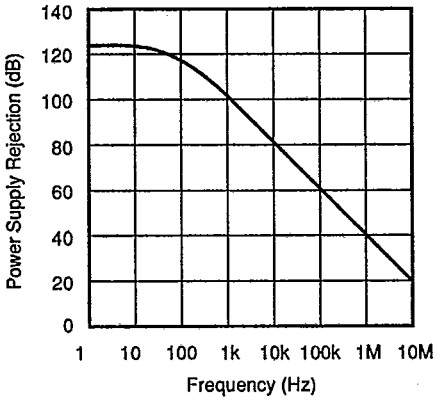
STEP RESPONSE



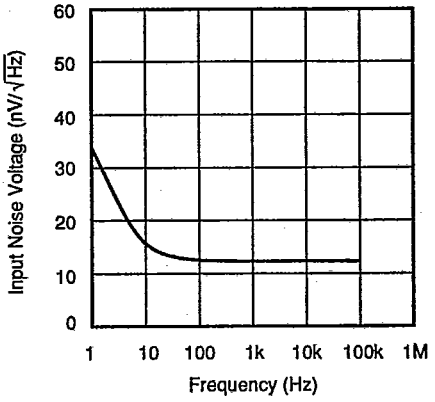
COMMON-MODE REJECTION vs FREQUENCY



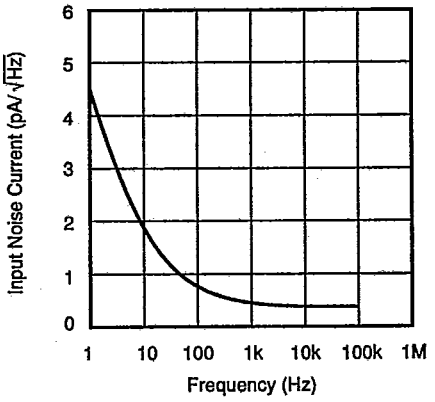
POWER SUPPLY REJECTION vs FREQUENCY



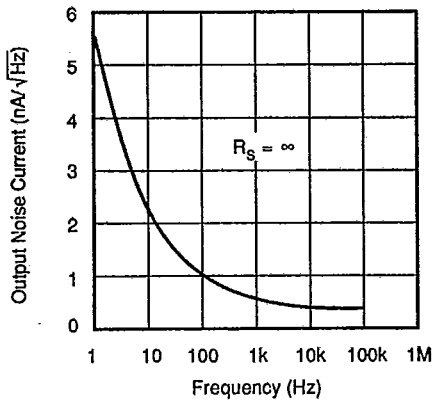
INPUT VOLTAGE NOISE DENSITY vs FREQUENCY



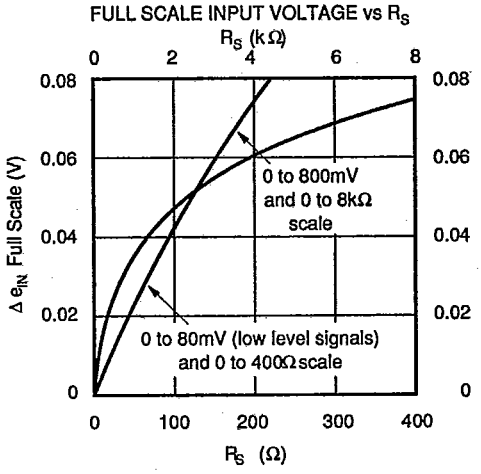
INPUT CURRENT NOISE DENSITY vs FREQUENCY



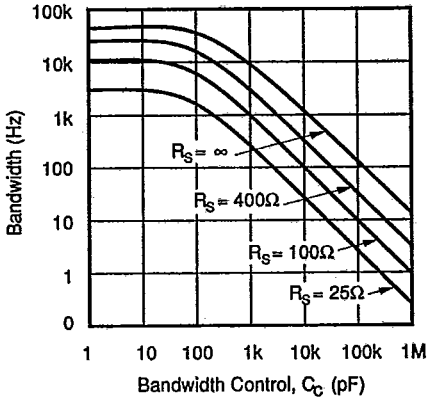
OUTPUT CURRENT NOISE DENSITY vs FREQUENCY



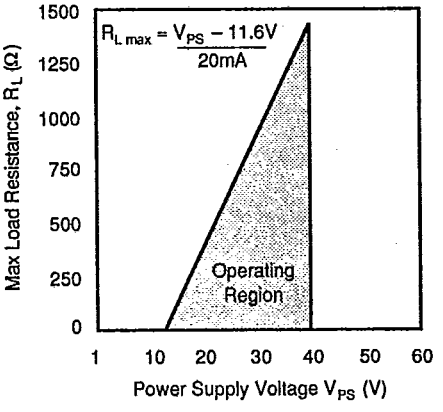
FULL SCALE INPUT VOLTAGE vs R_S



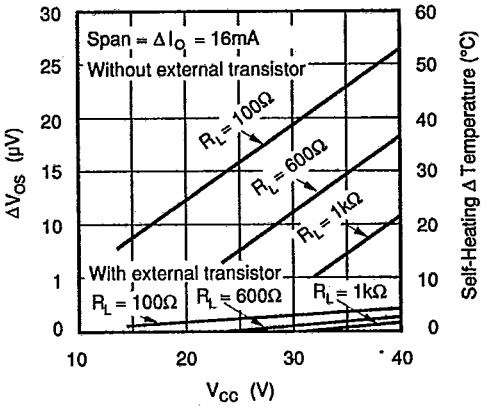
BANDWIDTH vs PHASE COMPENSATION



POWER SUPPLY OPERATING RANGE

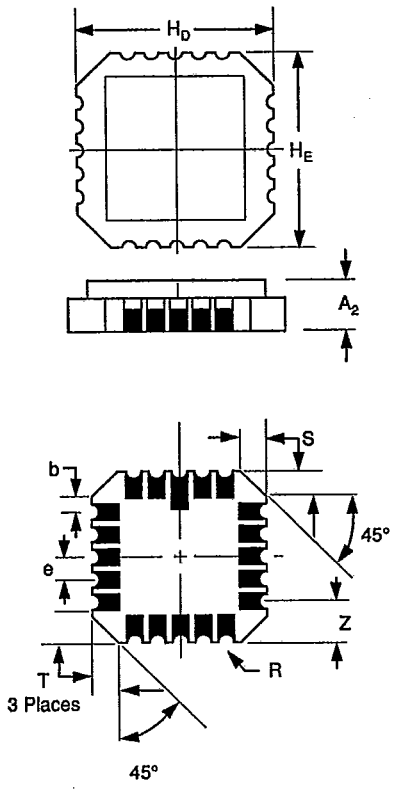


THERMAL FEEDBACK DUE TO CHANGE IN OUTPUT CURRENT

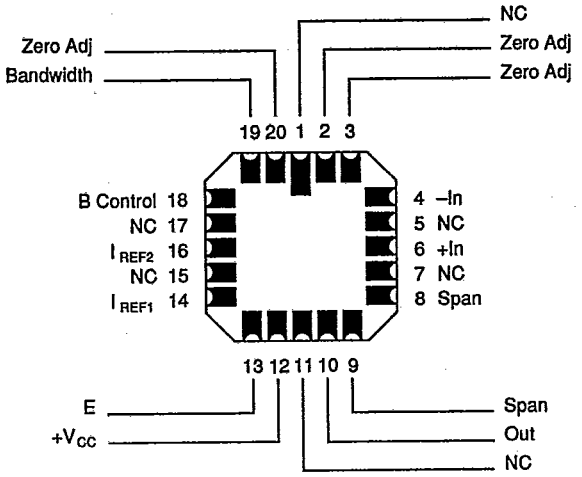


MECHANICAL

Ceramic LCC-20 Package



	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
H_D	.345	.360	8.76	9.14
H_E	.345	.360	8.76	9.14
A_2	.064	.100	1.63	2.54
b	.022	.028	0.56	0.71
e	.050 BASIC		1.27 BASIC	
R	.008R TYP		0.20R TYP	
S	.020 TYP		0.508 TYP	
T	.040 TYP		1.016 TYP	
Z	.075 TYP		1.91 TYP	



APPLICATION INFORMATION

The small size, low offset voltage and drift, excellent linearity, and internal precision current sources, make the XTR101L ideal for a variety of two-wire transmitter applications. It can be used by OEMs producing different types of transducer transmitter modules and by data acquisition systems manufacturers who gather transducer data. Current mode transmission greatly reduces noise interference. The two-wire nature of the device allows economical signal conditioning at the transducer. Thus the XTR101L is, in general, very suitable for individualized and special purpose applications.

Refer to PDS-627 for applications circuits and for further information.

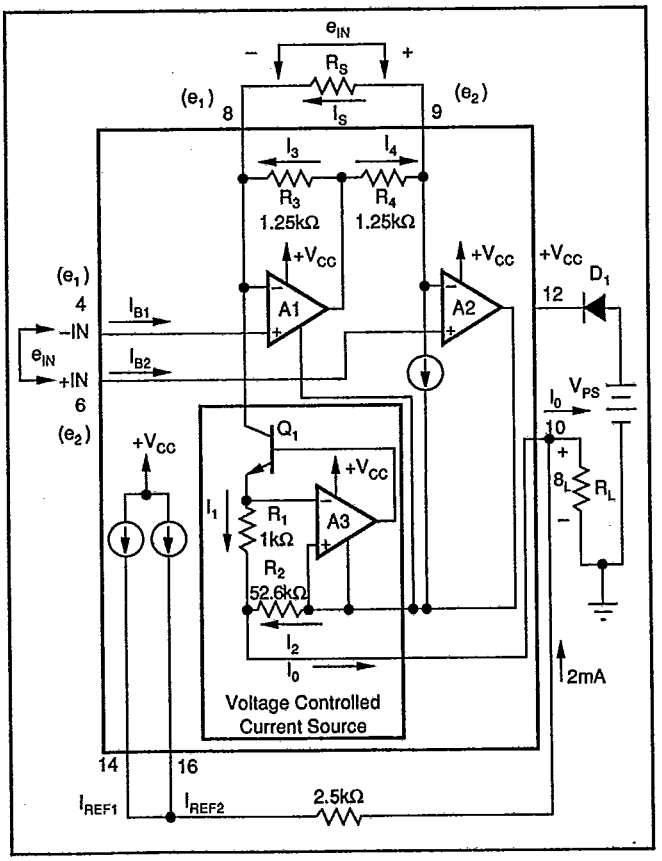


FIGURE 1. Simplified Schematic of the XTR101L.