F10115 • F10116 • F10515 • F10516
LINE RECEIVERS

DESCRIPTION — The F10115 and F10116 are differential amplifiers with low impedance emitter-follower outputs. An internal reference supply (V_{BB}) is available for added versatility. Active current sources provide improved common mode rejection. The F10115 is a quad line receiver with single ended outputs. The F10116 is a triple line receiver with complementary outputs. The devices are voltage compensated and are fully compatible with other 10,000 series devices. The line receivers are used primarily to receive data from balanced twisted pair lines, however, with appropriate connections and feedback, they may operate as Schmitt triggers, high-speed comparators, oscillators, or broadband amplifiers.

TRUTH TABLES

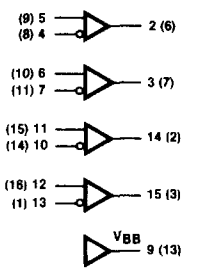
F10115 Quad Line Receiver

NON-INVERTING INPUT	INVERTING INPUT	OUTPUT
L	H	L
H	L	H
L	V_{BB}	L
H	V_{BB}	H
V_{BB}	H	L
V_{BB}	L	H

F10116 Triple Differential Line Receiver

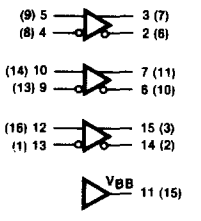
NON-INVERTING INPUT	INVERTING INPUT	OUTPUT	$\overline{\text{OUTPUT}}$
L	H	L	H
H	L	H	L
L	V_{BB}	L	H
H	V_{BB}	H	L
V_{BB}	H	L	H
V_{BB}	L	H	L

LOGIC DIAGRAM



( ) = Flatpak

F10115 • F10515



( ) = Flatpak

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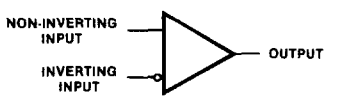
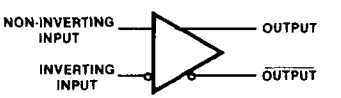
FUNCTIONS



V_{CC1} = 1 (5)
V_{CC2} = 16 (4)
V_{EE} = 8 (12)



V_{CC1} = 1 (5)
V_{CC2} = 16 (4)
V_{EE} = 8 (12)

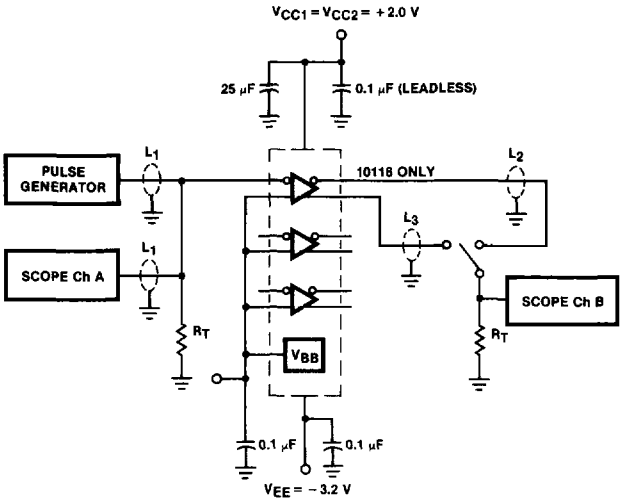
DC CHARACTERISTICS: $V_{EE} = -5.2$ V, $V_{CC} = GND$

SYMBOL	CHARACTERISTIC		LIMITS B	LIMITS TYP	LIMITS A	UNITS	T_A	CONDITIONS
I_{IH}	Input Current HIGH				95	μA	25°C	$V_{IN} = V_{IHA}$
I_{CBO}	Input Collector—Base Leakage Current		−1.0			μA	25°C	$V_{IN} = -5.2$ V
I_{EE}	Power Supply Current	F10115	−26	−18		mA	25°C	Pins 4, 7, 10, 13 = V_{ILB}' Pins 5, 6, 11, 12 = V_{BB}
		F10116	−21	−14		mA	25°C	Pins 4, 9, 12 = V_{ILB}' Pins 5, 10, 13 = V_{BB}
V_{BB}	Reference Voltage		−1380		−1255	mV	0°C	F10115, Connect pins i.e.; 5, 6, 11, 12 to pin 9
			−1350		−1230		25°C	
			−1305		−1165		75°C	F10116, Connect Pins i.e.; 5, 10, 13 to pin 11
V_{BB}	Reference Voltage		−1440		−1320		−55°C	F10115, Connect pins i.e.; 5, 6, 11, 12 to pin 9
			−1350		−1230		25°C	
			−1240		−1120		125°C	F10116, Connect Pins i.e.; 5, 10, 13 to pin 11

SWITCHING CHARACTERISTICS: $V_{EE} = -5.2$ V, $T_A = 25°C$

SYMBOL	CHARACTERISTIC	LIMITS B	LIMITS TYP	LIMITS A	UNITS	CONDITIONS
t_{PLH}, t_{PHL}	Propagation Delay	1.0	2.0	2.9	ns	See Figure 1
t_{TLH}, t_{THL}	Output Transition Time LOW to HIGH, HIGH to LOW (20% to 80%) (80% to 20%)	1.5	2.2	3.3	ns	

SWITCHING CIRCUIT AND WAVEFORMS



One input from each gate must be tied to V_{BB} during testing.

L_1, L_2, and L_3 = equal length 50Ω impedance lines.

R_T = 50Ω termination of scope

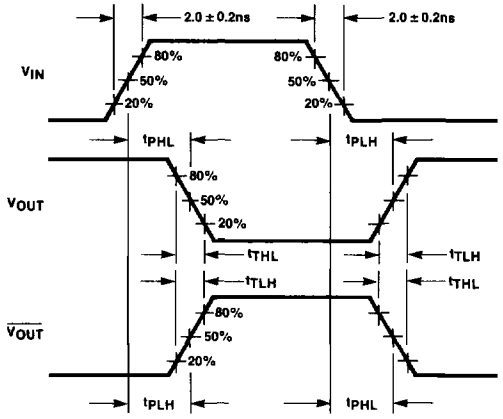


Fig.1

A line receiver is shown in *Figure 2*. The line is normally terminated in its characteristic impedance (typically 100 Ω) and output pull down resistors (typically 510 Ω) are used. The voltage across the terminating resistor V_T may be calculated as follows:

$$V_T = \frac{(V_{EE} - V_{OH})\, R_T}{R_E + R_T + R_{LINE}}$$

Where V_{OH} is the output voltage HIGH of the driving gate, R_{LINE} is the resistance and R_T is the terminating resistor. With typical values, V_T is 620 mV. The line receivers have a minimum differential input voltage gain of 7 V/V allowing very long twisted pairs to be driven. The line receivers employ active current sources which allow them to reject common mode inputs between -0.55 and -3 V.

Information transfer is often organized with a data bus approach, where many sources may input and receive data on a common bus as illustrated in *Figure 3*. This configuration is a special case of wired-OR and the line receiver inputs are essentially single ended which reduces worst case voltage gain to 3.5 V/V. In practice it is possible to transmit data at rates in excess of 100 MHz over bus lengths of 10 feet, having 10 or more receivers and transmitters on the line.

Twisted pair differential lines are recommended for clock distribution since clock skew may be balanced by adjusting line lengths. Propagation time is approximately 1 ns per eight inches of line.

TWISTED-PAIR CONNECTIONS

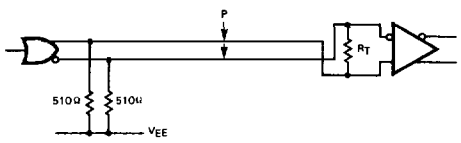


Fig. 2. Differential Transmission and Reception

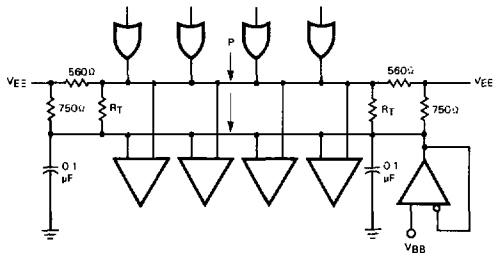


Fig. 3. Backplane Data Bus

PARAMETERS FOR LINEAR APPLICATIONS

V_{EE} = -5.2 V, V_{CC} = GND, T_A = 25°C

PARAMETER	LIMITS			UNITS
	B	TYP	A	
Voltage Gain	3.5	5.0	6.0	V/V
Bandwidth		60		MHz
Input Resistance	4	6		kΩ
Input Capacitance		3		pF
Input Offset Current		2		μA
Input Bias Current		17	30	μA
Common Mode Input Voltage Range	-3.0		-0.55	V
Common Mode Rejection Ratio	50			dB
Supply Voltage Rejection Ratio		35		dB
Output Voltage Swing		0.40		Vpp
Output Source Current			50	mA
Output Resistance		9		Ω

TYPICAL LINE RECEIVER DIFFERENTIAL GAIN VERSUS INPUT FREQUENCY