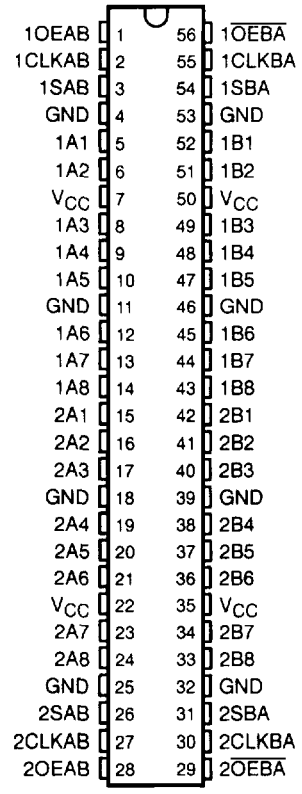
- **Members of the Texas Instruments *Widebus*™ Family**
- **State-of-the-Art *EPIC*-IIB™ BICMOS Design Significantly Reduces Power Dissipation**
- **Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17**
- **Typical V_{OLP} (Output Ground Bounce) < 1 V at V_{CC} = 5 V, T_A = 25°C**
- **Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise**
- **Flow-Through Architecture Optimizes PCB Layout**
- **High-Drive Outputs (–32-mA I_{OH}, 64-mA I_{OL})**
- **Package Options Include Plastic 300-mil Shrink Small-Outline (DL) Package and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings**

SN54ABT16652 . . . WD PACKAGE
SN74ABT16652 . . . DL PACKAGE
(TOP VIEW)



description

The 'ABT16652 are 16-bit bus transceivers that consist of D-type flip-flops and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. These devices can be used as two 8-bit transceivers or one 16-bit transceiver.

Output-enable (OEAB and $\overline{\text{OEBA}}$) inputs are provided to control the transceiver functions. Select-control (SAB and SBA) inputs are provided to select whether real-time or stored data is transferred. The circuitry used for select control eliminates the typical decoding glitch that occurs in a multiplexer during the transition between stored and real-time data. A low input selects real-time data, and a high input selects stored data. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the 'ABT16652.

Data on the A or B data bus, or both, can be stored in the internal D-type flip-flops by low-to-high transitions at the appropriate clock (CLKAB or CLKBA) inputs regardless of the select- or enable-control pins. When SAB and SBA are in the real-time transfer mode, it is possible to store data without using the internal D-type flip-flops by simultaneously enabling OEAB and $\overline{\text{OEBA}}$. In this configuration, each output reinforces its input. When all other data sources to the two sets of bus lines are at high impedance, each set of bus lines remains at its last state.

To ensure the high-impedance state during power up or power down, $\overline{\text{OEBA}}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver (B to A). OEAB should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver (A to B).

The SN74ABT16652 is available in TI's shrink small-outline package (DL), which provides twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

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description (continued)

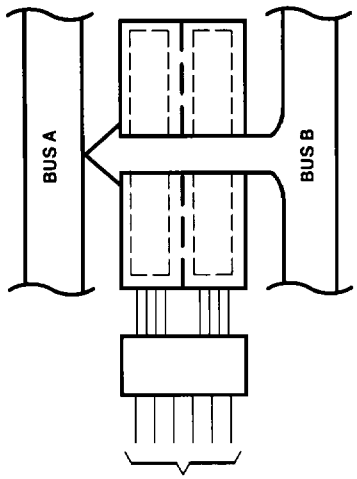
The SN54ABT16652 is characterized for operation over the full military temperature range of −55°C to 125°C. The SN74ABT16652 is characterized for operation from −40°C to 85°C.

FUNCTION TABLE

INPUTS						DATA I/O†		OPERATION OR FUNCTION
OEAB	$\overline{OEBA}$	CLKAB	CLKBA	SAB	SBA	A1 THRU A8	B1 THRU B8	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	↑	↑	X	X	Input	Input	Store A and B data
X	H	↑	H or L	X	X	Input	Unspecified‡	Store A, hold B
H	H	↑	↑	X‡	X	Input	Output	Store A in both registers
L	X	H or L	↑	X	X	Unspecified‡	Input	Hold A, store B
L	L	↑	↑	X	X‡	Output	Input	Store B in both registers
L	L	X	X	X	L	Output	Input	Real-time B data to A bus
L	L	X	H or L	X	H	Output	Input	Stored B data to A bus
H	H	X	X	L	X	Input	Output	Real-time A data to B bus
H	H	H or L	X	H	X	Input	Output	Stored A data to B bus
H	L	H or L	H or L	H	H	Output	Output	Stored A data to B bus and stored B data to A bus

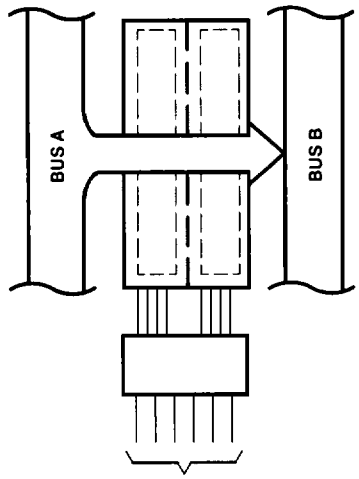
† The data output functions may be enabled or disabled by a variety of level combinations at the OEAB or $\overline{OEBA}$ inputs. Data input functions are always enabled; i.e., data at the bus pins is stored on every low-to-high transition on the clock inputs.

‡ Select control = L; clocks can occur simultaneously.
Select control = H; clocks must be staggered in order to load both registers.



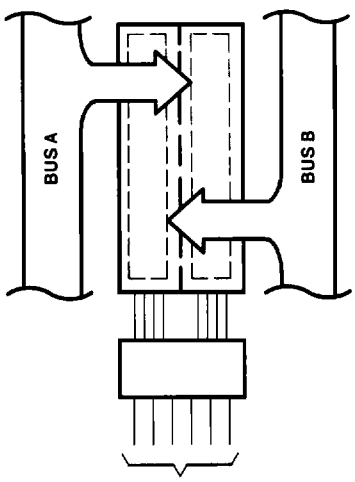
OEAB	$\overline{OEBA}$	CLKAB	CLKBA	SAB	SBA
L	L	X	X	X	L

REAL-TIME TRANSFER
BUS B TO BUS A



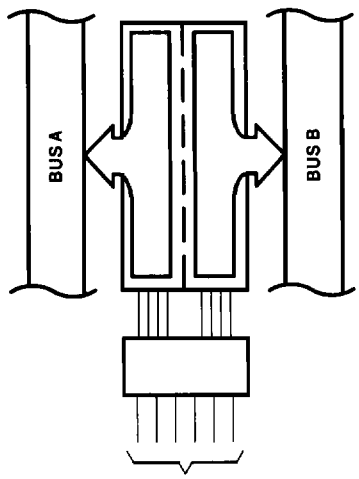
OEAB	$\overline{OEBA}$	CLKAB	CLKBA	SAB	SBA
H	H	X	X	L	X

REAL-TIME TRANSFER
BUS A TO BUS B



OEAB	$\overline{OEBA}$	CLKAB	CLKBA	SAB	SBA
X	H	↑	X	X	X
L	X	X	↑	X	X
L	H	↑	↑	X	X

STORAGE FROM
A, B, OR A AND B

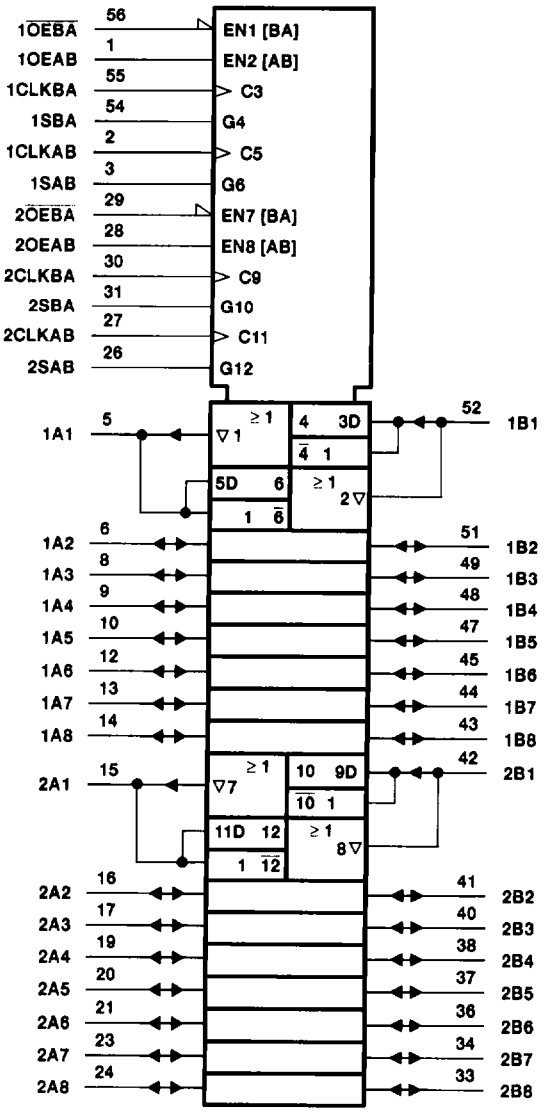


OEAB	$\overline{OEBA}$	CLKAB	CLKBA	SAB	SBA
H	L	L	L	H	H

TRANSFER STORED DATA
TO A AND/OR B

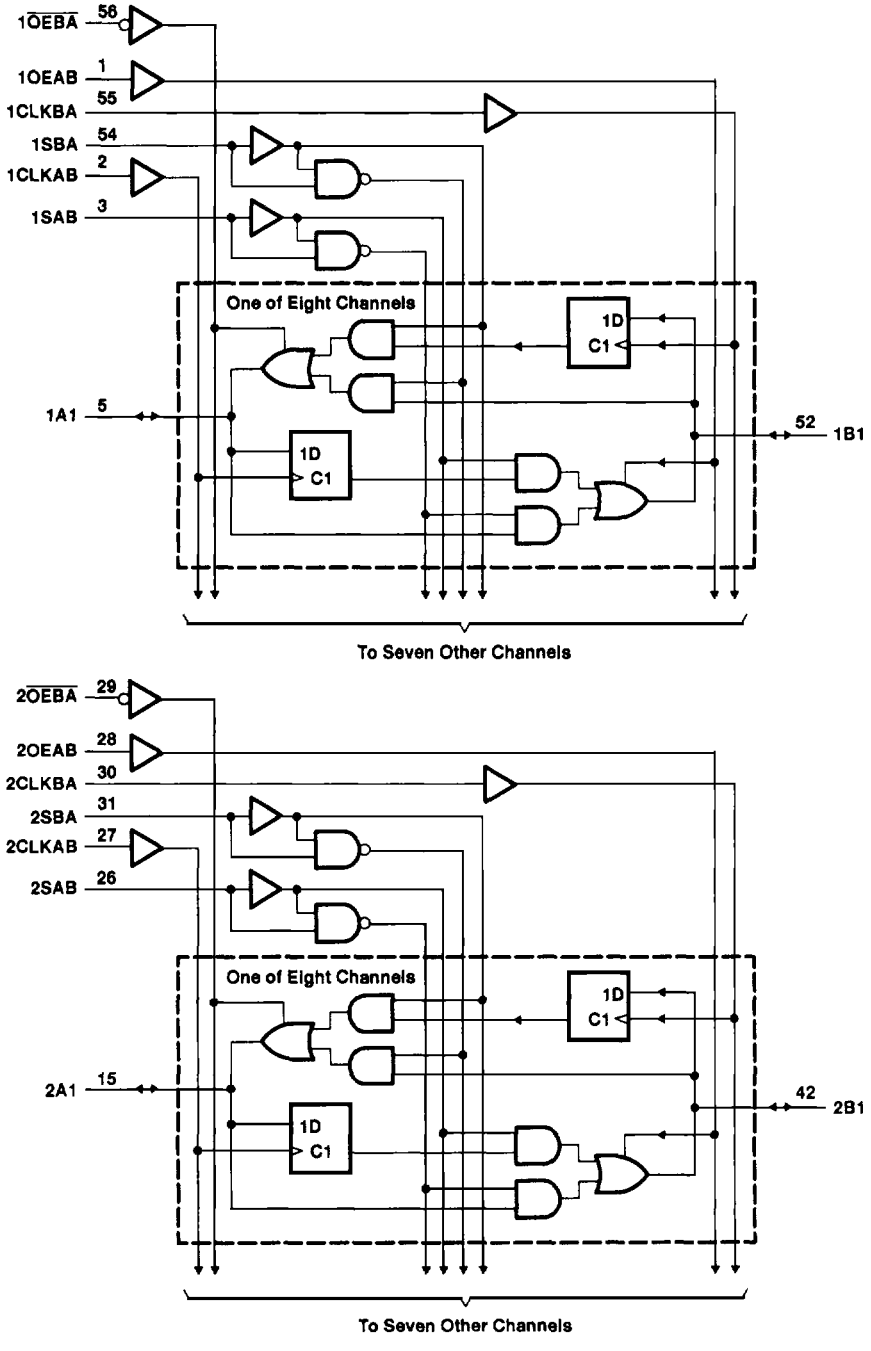
Figure 1. Bus-Management Functions

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC} ..... −0.5 V to 7 V
Input voltage range, V_I (except I/O ports) (see Note 1) ..... −0.5 V to 7 V
Voltage range applied to any output in the high state or power-off state, V_O ..... −0.5 V to 5.5 V
Current into any output in the low state, I_O: SN54ABT16652 ..... 96 mA
SN74ABT16652 ..... 128 mA
Input clamp current, I_{IK} ($V_I < 0$) ..... −18 mA
Output clamp current, I_{OK} ($V_O < 0$) ..... −50 mA
Maximum power dissipation at T_A = 55°C (in still air) (see Note 2): DL package ..... 1.4 W
Storage temperature range ..... −65°C to 150°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 under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils. For more information, refer to the *Package Thermal Considerations* application note in the 1994 *ABT Advanced BiCMOS Technology Data Book*, literature number SCBD002B.

recommended operating conditions (see Note 3)

			SN54ABT16652		SN74ABT16652		UNIT
			MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		4.5	5.5	4.5	5.5	V
V_{IH}	High-level input voltage		2		2		V
V_{IL}	Low-level input voltage			0.8		0.8	V
V_I	Input voltage		0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current			−24		−32	mA
I_{OL}	Low-level output current			48		64	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled		10		10	ns/V
T_A	Operating free-air temperature		−55	125	−40	85	°C

NOTE 3: Unused or floating pins (input or I/O) must be held high or low.

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

PARAMETER		TEST CONDITIONS		T_A = 25°C			SN54ABT16652		SN74ABT16652		UNIT
				MIN	TYP†	MAX	MIN	MAX	MIN	MAX	
V_{IK}		V_{CC} = 4.5 V,	I_I = −18 mA			−1.2		−1.2		−1.2	V
V_{OH}		V_{CC} = 4.5 V,	I_{OH} = −3 mA	2.5			2.5		2.5		V
		V_{CC} = 5 V,	I_{OH} = −3 mA	3			3		3		
		V_{CC} = 4.5 V	I_{OH} = −24 mA	2			2				
			I_{OH} = −32 mA	2*					2		
V_{OL}		V_{CC} = 4.5 V	I_{OL} = 48 mA			0.55		0.55			V
			I_{OL} = 64 mA			0.55*				0.55	
I_I	Control inputs	V_{CC} = 5.5 V,	V_I = V_{CC} or GND			±1		±1		±1	µA
	A or B ports	V_{CC} = 5.5 V,	V_I = V_{CC} or GND			±20		±20		±20	
I_{OZH}‡		V_{CC} = 5.5 V,	V_O = 2.7 V			10		10		10	µA
I_{OZL}‡		V_{CC} = 5.5 V,	V_O = 0.5 V			−10		−10		−10	µA
I_{off}		V_{CC} = 0,	V_I or V_O ≤ 4.5 V			±100				±100	µA
I_{CEX}	Outputs high	V_{CC} = 5.5 V,	V_O = 5.5 V			50		50		50	µA
I_O§		V_{CC} = 5.5 V,	V_O = 2.5 V	−50	−100	−180	−50	−180	−50	−180	mA
I_{CC}	A or B ports	V_{CC} = 5.5 V, I_O = 0, V_I = V_{CC} or GND	Outputs high			2		2		2	mA
			Outputs low			32		32		32	
			Outputs disabled			2		2		2	
ΔI_{CC}¶	Data inputs	V_{CC} = 5.5 V, One input at 3.4 V, Other inputs at V_{CC} or GND	Outputs enabled			50		50		50	µA
			Outputs disabled			50		50		50	
	Control inputs	V_{CC} = 5.5 V, One input at 3.4 V, Other inputs at V_{CC} or GND				50		50		50	
C_i	Control inputs	V_I = 2.5 V or 0.5 V			4						pF
C_{io}	A or B ports	V_O = 2.5 V or 0.5 V			8						pF

* On products compliant to MIL-STD-883, Class B, this parameter does not apply.
† All typical values are at V_{CC} = 5 V.
‡ The parameters I_{OZH} and I_{OZL} include the input leakage current.
§ Not more than one output should be tested at a time, and the duration of the test should not exceed one second.
¶ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 2)

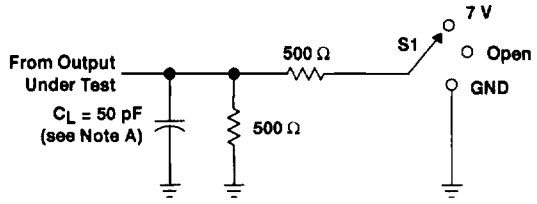
		V_{CC} = 5 V, T_A = 25°C		SN54ABT16652		SN74ABT16652		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency	0	125	0	125	0	125	MHz
t_w	Pulse duration, CLK high or low	4.3		4.3		4.3		ns
t_{su}	Setup time, A or B before CLKAB↑ or CLKBA↑	3		4		3		ns
t_h	Hold time, A or B after CLKAB↑ or CLKBA↑	0		0.5		0		ns

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C_L = 50 pF (unless otherwise noted) (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 5 V, T_A = 25°C			SN54ABT16652		SN74ABT16652		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			125			125		125		MHz
t_{PLH}	CLK	B or A	1.5	3.1	4	1	5	1.5	4.9	ns
t_{PHL}			1.5	3.2	4.1	1	5	1.5	4.7	
t_{PLH}	A or B	B or A	1	2.3	3.2	0.6	4	1	3.9	ns
t_{PHL}			1	3	4.1	0.6	4.9	1	4.6	
t_{PLH}	SAB or SBA†	B or A	1	2.9	4.3	0.6	5.3	1	5	ns
t_{PHL}			1	3.1	4.3	0.6	5.3	1	5	
t_{PZH}	$\overline{OEBA}$	A	1	2.8	4.1	0.6	5.2	1	5	ns
t_{PZL}			1.5	3.1	4.4	1	5.4	1.5	5.3	
t_{PHZ}	$\overline{OEBA}$	A	1.5	3.4	4.4	0.8	5.3	1.5	4.9	ns
t_{PLZ}			1.5	2.7	3.6	1	5.3	1.5	4	
t_{PZH}	OEAB	B	1	2.6	3.6	0.8	4.7	1	4.2	ns
t_{PZL}			1.5	2.8	3.9	1	5	1.5	4.6	
t_{PHZ}	OEAB	B	2	4.2	5.5	1	6.4	2	5.9	ns
t_{PLZ}			1.5	3.4	4.5	1	5.9	1.5	5.2	

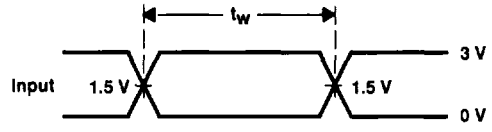
† These parameters are measured with the internal output state of the storage register opposite to that of the bus input.

PARAMETER MEASUREMENT INFORMATION

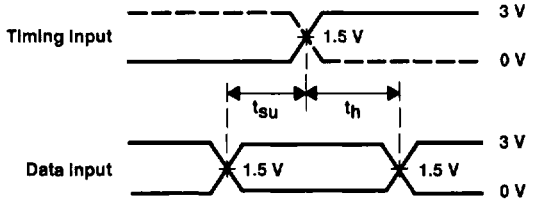


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open

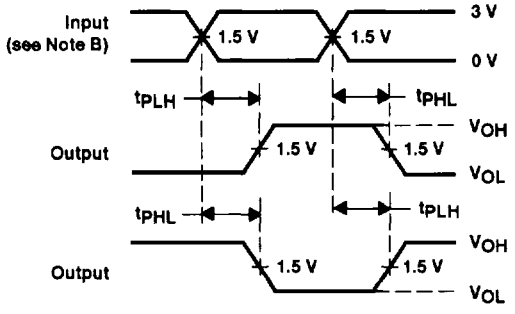
LOAD CIRCUIT FOR OUTPUTS



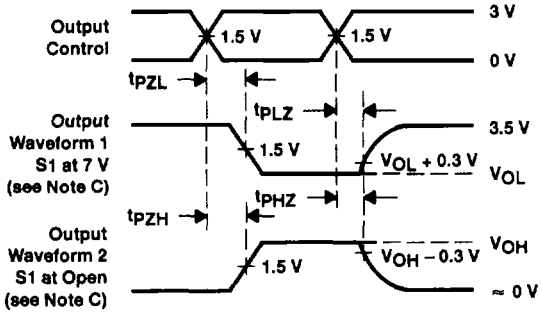
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

NOTES: A. C_L includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
C. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
D. The outputs are measured one at a time with one transition per measurement.

Figure 2. Load Circuit and Voltage Waveforms