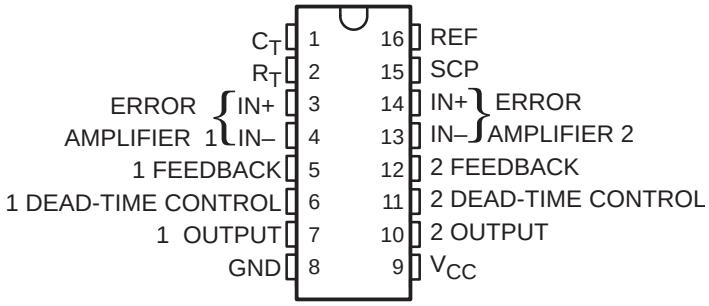
SLVS039A – FEBRUARY 1990 – REVISED DECEMBER 1990

- **Complete PWM Power Control Circuitry**
- **Completely Synchronized Operation**
- **Internal Undervoltage Lockout Protection**
- **Wide Supply Voltage Range**
- **Oscillator Frequency . . . 500 kHz Max**
- **Variable Dead Time Provides Control Over Total Range**
- **Internal Regulator Provides a Stable 2.5-V Reference Supply**

N OR NS PACKAGE
(T0P VIEW)



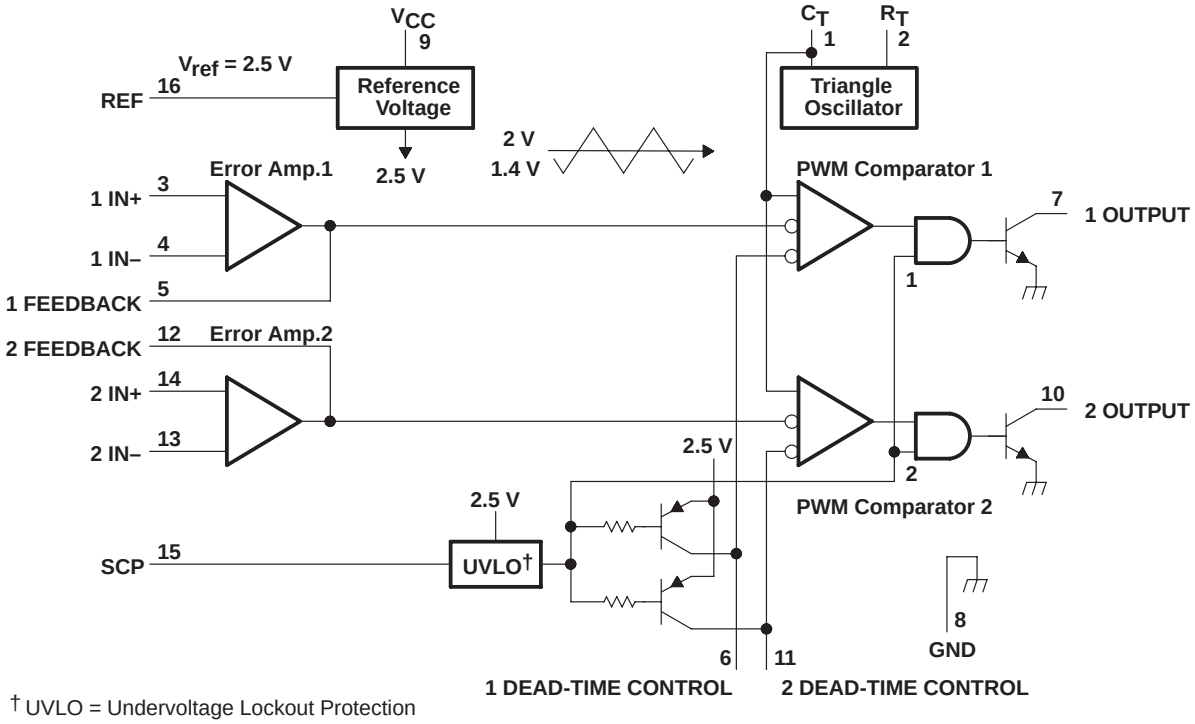
description

The TL1453C incorporates the functions required in the construction of two pulse-width-modulation control circuits on a single monolithic chip. Designed primarily for power supply control, the TL1453C contains an on-chip 2.5-V regulator, two error amplifiers, an adjustable oscillator, two dead-time comparators, undervoltage lockout circuitry, and dual common-emitter output transistor circuits.

The uncommitted output transistors provide common-emitter output capability for each controller. The internal amplifiers exhibit a common-mode voltage range from 1.05 V to 1.45 V. The dead-time control comparator has no offset unless externally altered and may be used to provide 0% to 100% dead time. The on-chip oscillator may be operated by terminating R_T (pin 2) and C_T (pin 1). During low-V_{CC} conditions, the undervoltage lockout control circuit feature inhibits the output until the internal circuitry is operational.

The TL1453C is characterized for operation from –20°C to 85°C.

functional block diagram



† UVLO = Undervoltage Lockout Protection

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

Supply voltage, V_{CC} (see Note 1) . . . . . 41 V
Amplifier input voltage . . . . . 20 V
Collector output voltage . . . . . 51 V
Collector output current . . . . . 21 mA
Continuous total power dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, T_A . . . . . –20°C to 85°C
Storage temperature range . . . . . –65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°C

NOTE 1: All voltage values are with respect to network ground terminal.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 85°C$ POWER RATING
N	1000 mW	8 mW/°C	520 mW
NS	725 mW	5.8 mW/°C	397 mW

recommended operating conditions

	MIN	MAX	UNIT
Supply voltage, V_{CC}	3.6	40	V
Amplifier input voltage, V_I	1.05	1.45	V
Collector output voltage, V_O		50	V
Collector output current		20	mA
Current into feedback terminal		45	μA
Feedback resistor, R_F	100		kΩ
Timing capacitor, C_T	150	15000	pF
Timing resistor, R_T	5.1	100	kΩ
Oscillator frequency	1	500	kHz
Operating free-air temperature, T_A	–20	85	°C

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 6 V, f = 200 kHz (unless otherwise noted)

reference section

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Output voltage (pin 16)	I_O = 1 mA	2.4	2.5	2.6	V
Output voltage change with temperature	T_A = –20°C to 25°C		–0.1%	±1%	
	T_A = 25°C to 85°C		–0.2%	±1%	
Input regulation	V_{CC} = 3.6 V to 40 V		2	12.5	mV
Output regulation	I_O = 0.1 mA to 1 mA		1	7.5	mV
Short-circuit output current	V_O = 0	3	10	30	mA

† All typical values are at T_A = 25°C.

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 6 V, f = 200 kHz (unless otherwise noted) (continued)

undervoltage lockout section

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Upper threshold voltage (pin 9)	I_{Oref} = 0.1 mA, T_A = 25°C		2.72		V
Lower threshold voltage (pin 9)	I_{Oref} = 0.1 mA, T_A = 25°C		2.6		V
Hysteresis (pin 9)	I_{Oref} = 0.1 mA, T_A = 25°C	80	120		mV

oscillator section

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Frequency	C_T = 330 pF, R_T = 10 kΩ		200		kHz
Standard deviation of frequency	V_{CC}, T_A, R_T, C_T values are constant		10%		
Frequency change with voltage	V_{CC} = 3.6 V to 40 V		1%		
Frequency change with temperature	T_A = –20°C to 25°C		–0.4%	±2%	
	T_A = 25°C to 85°C		–0.2%	±2%	

dead-time control section

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Input bias current (pins 6 and 11)				1	μA
Input threshold voltage at f = 10kHz (pins 6 and 11)	Zero duty cycle		2.05	2.25	V
	Maximum duty cycle	1.2	1.45		

error-amplifier section

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Input offset voltage	V_O (pins 5 and 12) = 1.25 V			±6	mV
Input offset current	V_O (pins 5 and 12) = 1.25 V			±100	nA
Input bias current	V_O (pins 5 and 12) = 1.25 V		160	500	nA
Common-mode input voltage range	V_{CC} = 3.6 V to 40 V	1.05 to 1.45			V
Open-loop voltage amplification	R_F = 200 kΩ	70	80		dB
Unity-gain bandwidth			1.5		MHz
Common-mode rejection ratio		60	80		dB
Positive output voltage swing		V_{ref}–0.1			V
Negative output voltage swing				1	V
Output (sink) current (pins 5 and 12)	V_{ID} = –0.1 V, V_O = 1.25 V	0.5	1.6		mA
Output (source) current (pins 5 and 12)	V_{ID} = 0.1 V, V_O = 1.25 V	–45	–70		μA

output section

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Collector off-state current	V_{CC} = 0, V_O = 50 V			10	μA
	V_O = 50 V			10	
Output saturation voltage	I_O = 10 mA		1.2	2	V
Short-circuit output current	V_O = 6 V		90		mA

† All typical values are at T_A = 25°C.

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 6 V, f = 200 kHz (unless otherwise noted) (continued)

pwm comparator section

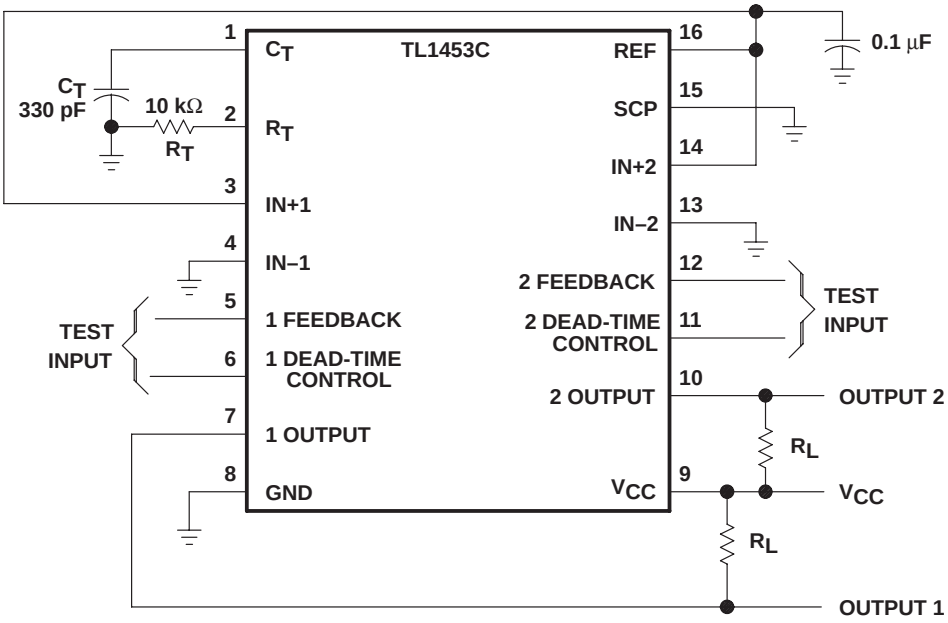
PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Input threshold voltage at f = 10 kHz (pins 5 and 12)	Zero duty cycle		2.05	2.25	V
	Maximum duty cycle	1.2	1.45		
Input (sink) current (pins 5 and 12)	V_I = 1.25 V	0.5	1.6		mA
Input (source) current (pins 5 and 12)	V_I = 1.25 V	–45	–70		μA

total device

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Standby supply current	Off-state		1.3	1.8	mA
Average supply current	R_T = 10 kΩ		1.7	2.4	mA

† All typical values are at T_A = 25°C.

test circuit



PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TL1453CD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		TL1453C	Samples
TL1453CN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type		TL1453CN	Samples
TL1453CNSLE	OBSOLETE	SO	NS	16		TBD	Call TI	Call TI			
TL1453CNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		TL1453	Samples
TL1453CNSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		TL1453	Samples
TL1453CPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		T1453	Samples
TL1453CPWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM		T1453	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

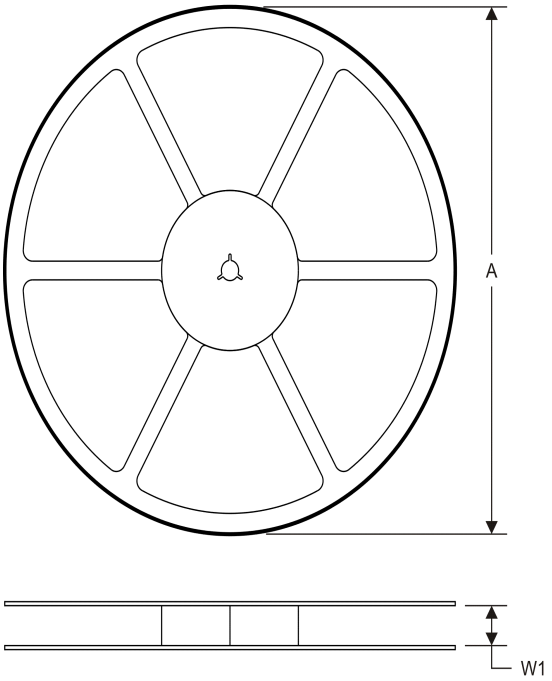
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

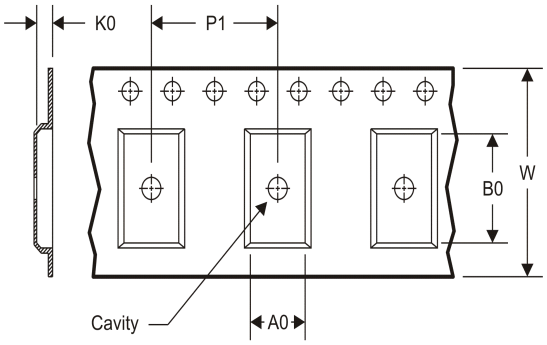
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



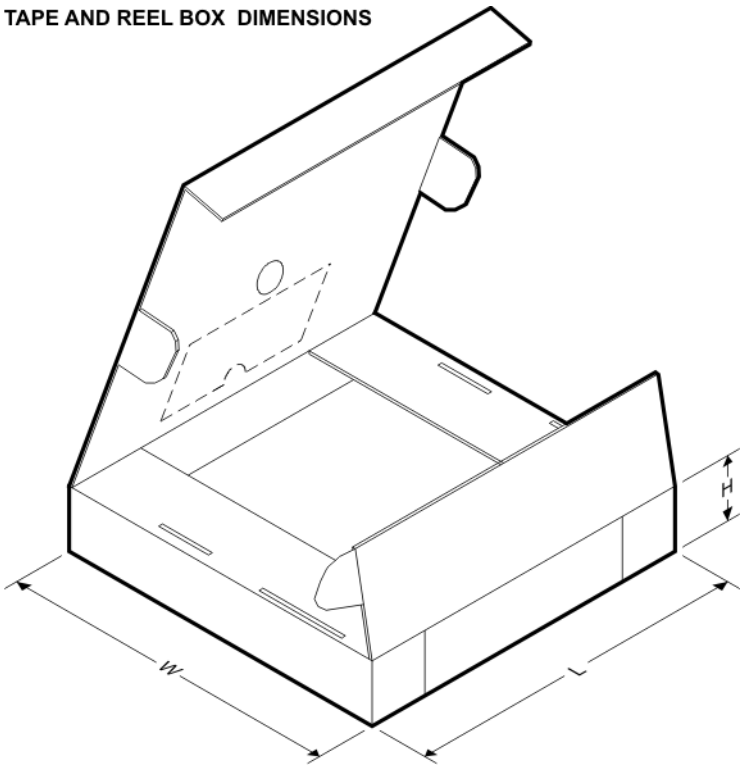
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

TAPE AND REEL INFORMATION

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TL1453CNSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
TL1453CPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TL1453CNSR	SO	NS	16	2000	367.0	367.0	38.0
TL1453CPWR	TSSOP	PW	16	2000	367.0	367.0	35.0

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