

## LM195QML Ultra Reliable Power Transistors

### FEATURES

- Internal Thermal Limiting
- Greater Than 1.0A Output Current
- 3.0  $\mu$ A Typical Base Current
- 500 ns Switching Time
- 2.0V Saturation
- Base Can be Driven up to 40V Without Damage
- Directly Interfaces with CMOS or TTL
- 100% Electrical Burn-in

### DESCRIPTION

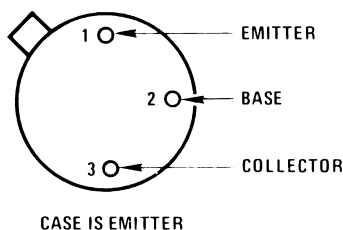
The LM195 is a fast, monolithic power integrated circuit with complete overload protection. This device, which acts as a high gain power transistor, has included on the chip, current limiting, power limiting, and thermal overload protection making it virtually impossible to destroy from any type of overload.

The inclusion of thermal limiting, a feature not easily available in discrete designs, provides virtually absolute protection against overload. Excessive power dissipation or inadequate heat sinking causes the thermal limiting circuitry to turn off the device preventing excessive heating.

The LM195 offers a significant increase in reliability as well as simplifying power circuitry. In some applications, where protection is unusually difficult, such as switching regulators, lamp or solenoid drivers where normal power dissipation is low, the LM195 is especially advantageous.

The LM195 is easy to use and only a few precautions need be observed. Excessive collector to emitter voltage can destroy the LM195 as with any power transistor. When the device is used as an emitter follower with low source impedance, it is necessary to insert a 5.0k resistor in series with the base lead to prevent possible emitter follower oscillations. Although the device is usually stable as an emitter follower, the resistor eliminates the possibility of trouble without degrading performance. Finally, since it has good high frequency response, supply bypassing is recommended.

### Connection Diagram



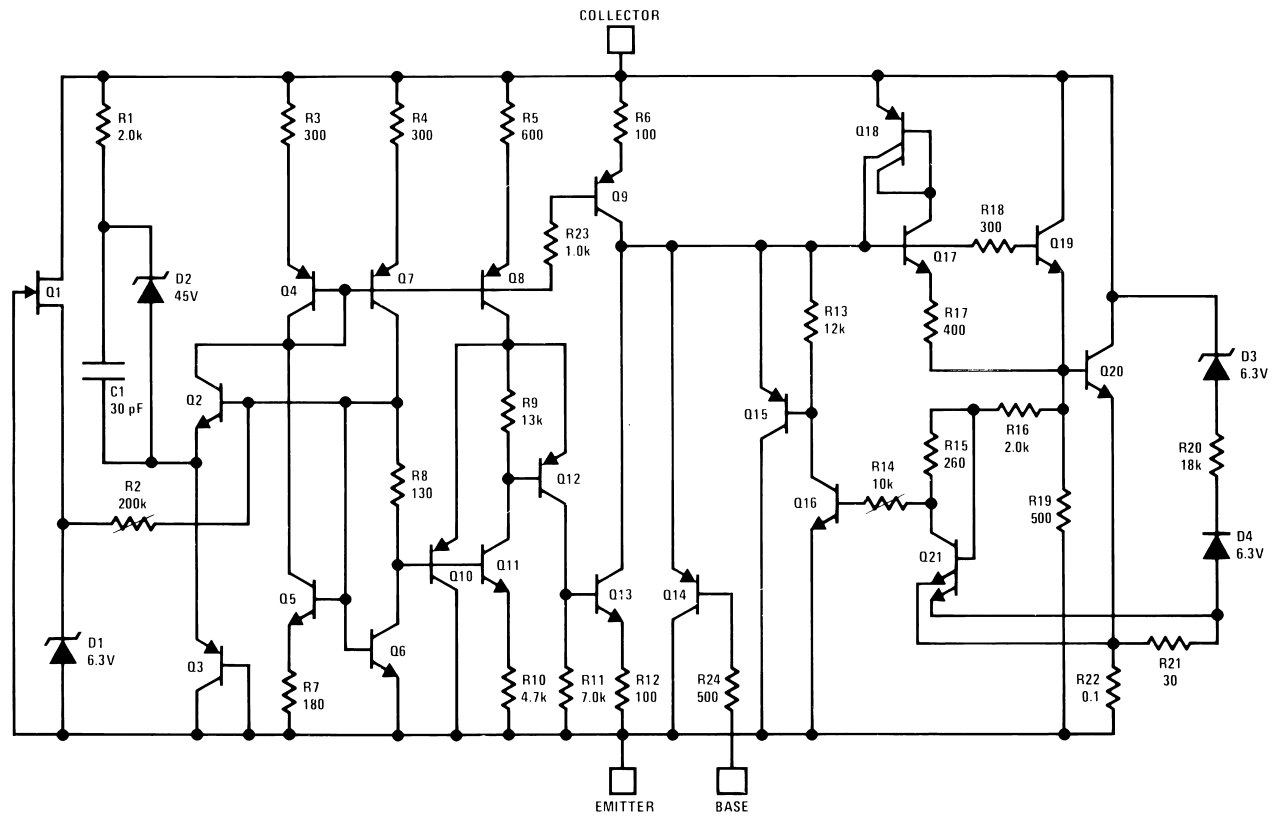
**Figure 1. 5-Pin TO - Bottom View**  
See NDT0003A Package



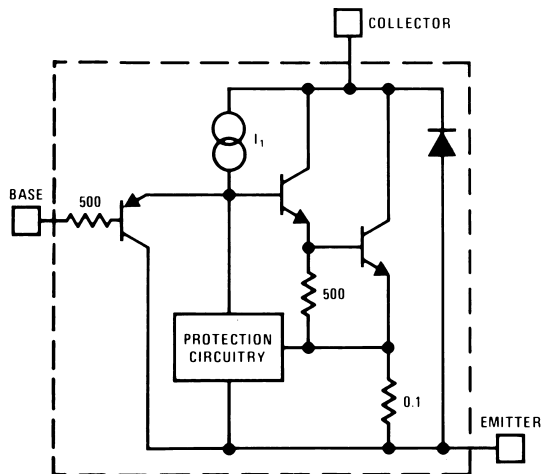
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

All trademarks are the property of their respective owners.

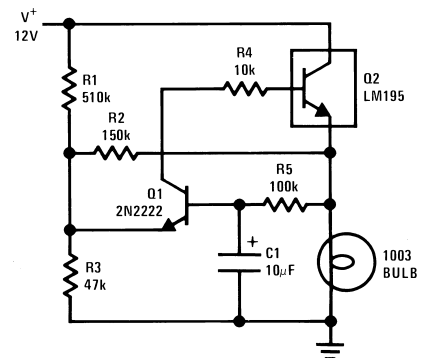
## Schematic Diagram



## Simplified Circuit



### 1.0 Amp Lamp Flasher



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

**Absolute Maximum Ratings<sup>(1)</sup>**

Collector to Emitter Voltage			42V
Collector to Base Voltage			42V
Base to Emitter Voltage (Forward)			42V
Base to Emitter Voltage (Reverse)			20V
Collector Current			Internally Limited
Power Dissipation <sup>(2)</sup>			Internally Limited
Operating Temperature Range	TO package		-55°C ≤ T <sub>A</sub> ≤ +125°C
Storage Temperature Range			-65°C ≤ T <sub>A</sub> ≤ +150°C
Lead Temperature (Soldering, 10 sec.)			260°C
Thermal Resistance	θ <sub>JA</sub>	TO package; Still Air at 0.5W	192°C/W
		TO package; 500LF/Min Air Flow at 0.5W	66°C/W
	θ <sub>JC</sub>	TO package at 1.0W	29°C/W

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
- (2) The maximum power dissipation must be derated at elevated temperatures and is dictated by T<sub>Jmax</sub> (maximum junction temperature), θ<sub>JA</sub> (package junction to ambient thermal resistance), and T<sub>A</sub> (ambient temperature). The maximum allowable power dissipation at any temperature is P<sub>Dmax</sub> = (T<sub>Jmax</sub> - T<sub>A</sub>)/θ<sub>JA</sub> or the number given in the Absolute Maximum Ratings, whichever is lower.

**Quality Conformance Inspection**
**Table 1. Mil-Std-883, Method 5005 - Group A**

Subgroup	Description	Temp (°C)
1	Static tests at	+25
2	Static tests at	+125
3	Static tests at	-55
4	Dynamic tests at	+25
5	Dynamic tests at	+125
6	Dynamic tests at	-55
7	Functional tests at	+25
8A	Functional tests at	+125
8B	Functional tests at	-55
9	Switching tests at	+25
10	Switching tests at	+125
11	Switching tests at	-55
12	Settling time at	+25
13	Settling time at	+125
14	Settling time at	-55

**LM195H/883 Electrical Characteristics DC Parameter Collector to Emitter**

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V <sub>CE</sub>	Operating Voltage	I <sub>C</sub> ≤ I <sub>Max</sub>	See <sup>(1)</sup>		42	V	1, 2, 3

- (1) Parameter tested go-no-go only.

**LM195H/883 Electrical Characteristics DC Parameter Base to Emitter**

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
$BV_{BE}$	Breakdown Voltage	$V_{CE} \leq 42V$	See <sup>(1)</sup>	42		V	1, 2, 3
$I_{SC}$	Collector Current	$V_{CE} \leq 7V$		1.2		A	1
				1		A	2, 3
$V_{Sat}$	Saturation Voltage	$I_C = 1A$			2	V	1, 2
					2.5	V	3
$I_B$	Base Current	$0 \leq V_{BE} \leq 42V$ , $I_C \leq I_{Max}$			5	$\mu A$	1, 2, 3
$I_Q$	Quiescent Current	$V_{CE} = 42V$ , $V_{BE} = 0V$			5	mA	1, 2, 3
$V_{Bk}$	Breakdown Delta $V_{BE}$	$V_C = 46-42V$ , $I_L = 50mA$		-0.03	0.01	V	1
		$V_C = 46-38V$		-0.03	0.01	V	1
		$V_C = 50-42V$		-0.03	0.01	V	1
Thr	Thermal Response	100 $\mu S$		-10	100	mV	1
		500 $\mu S$		-10	70	mV	1
		2mS		-10	50	mV	1
		20mS		-10	10	mV	1

(1) Parameter tested go-no-go only.

**LM195H/883 Electrical Characteristics AC Parameter**

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
$t_{ON}$	Response Time	$V_I = 0-2V$ , $R_L = 36\Omega$ , $V_+ = 36V$			1.8	$\mu S$	9, 10, 11
$t_{OFF}$	Response Time	$V_I = 2-0V$ , $R_L = 36\Omega$ , $V_+ = 36V$			1.8	$\mu S$	9, 10, 11

## Typical Performance Characteristics

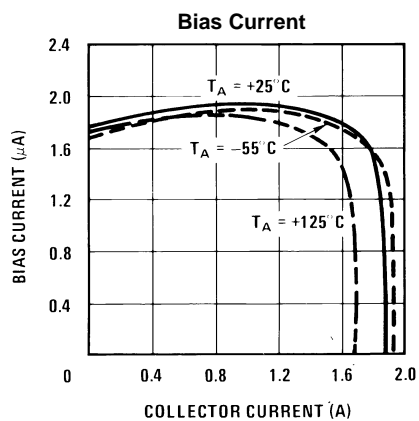


Figure 2.

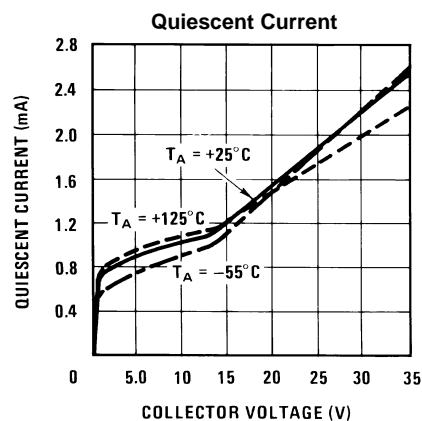


Figure 3.

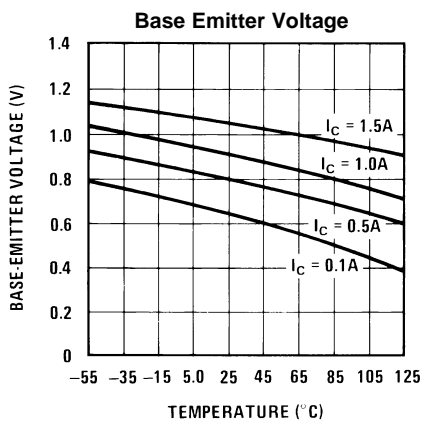


Figure 4.

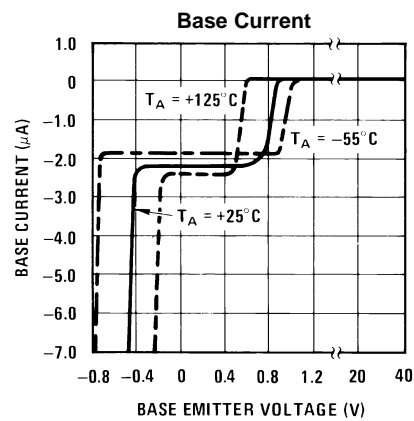


Figure 5.

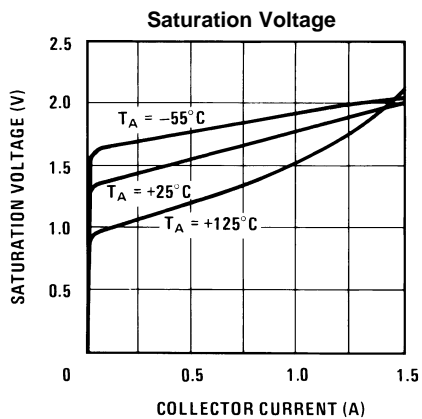


Figure 6.

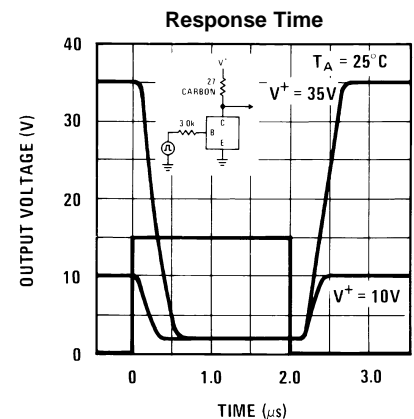


Figure 7.

## Typical Performance Characteristics (continued)

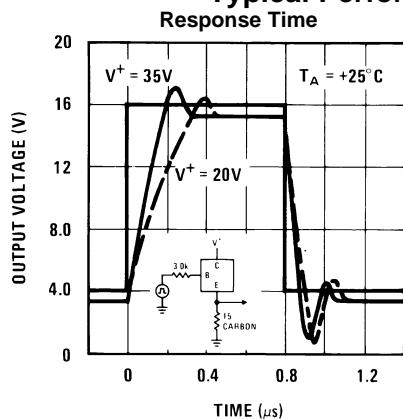


Figure 8.

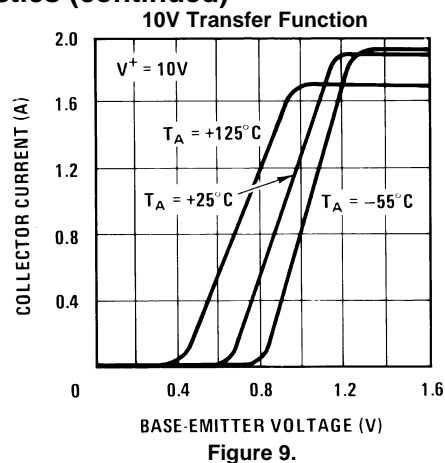


Figure 9.

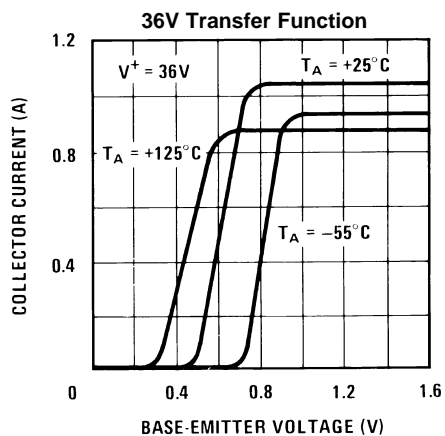


Figure 10.

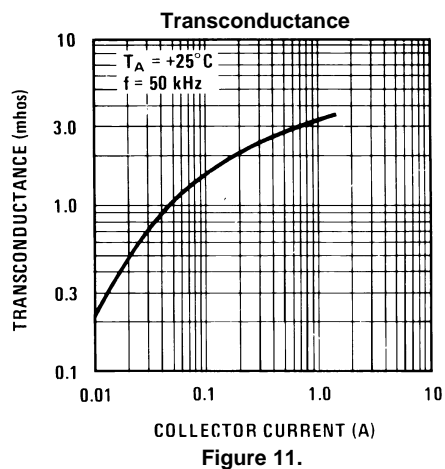


Figure 11.

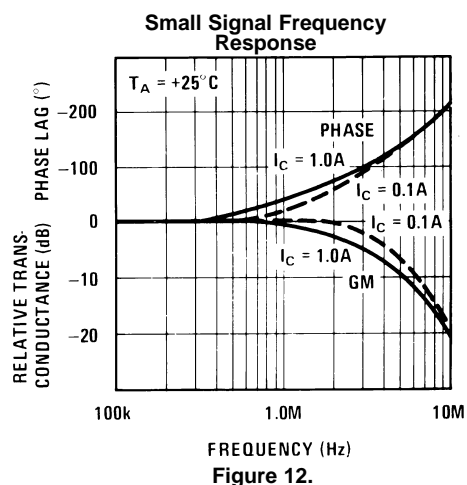
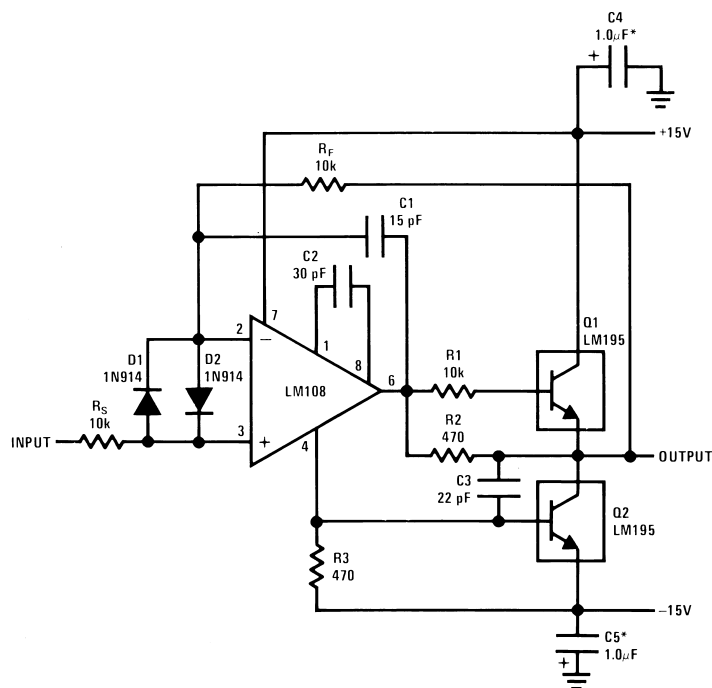


Figure 12.

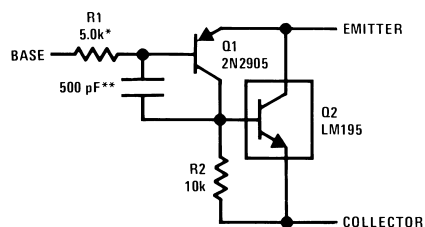
## Typical Applications

### 1.0 Amp Voltage Follower



\*Solid Tantalum

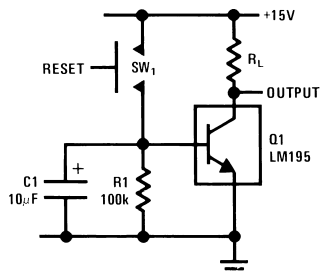
### Power PNP



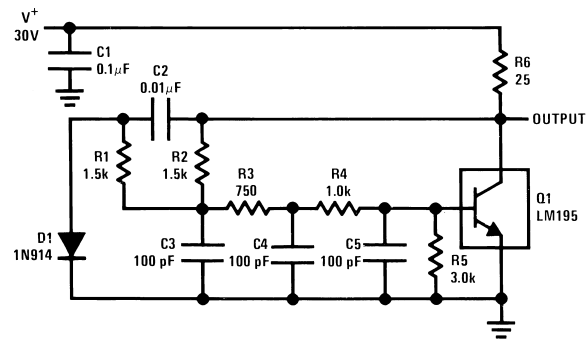
\*Protects against excessive base drive

\*\*Needed for stability

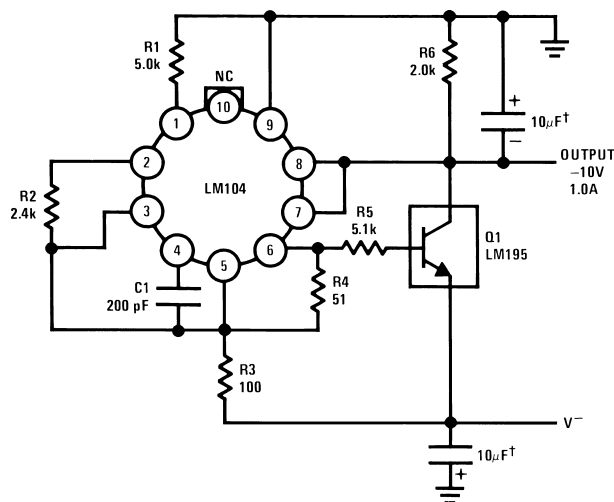
### Time Delay



### 1.0 MHz Oscillator

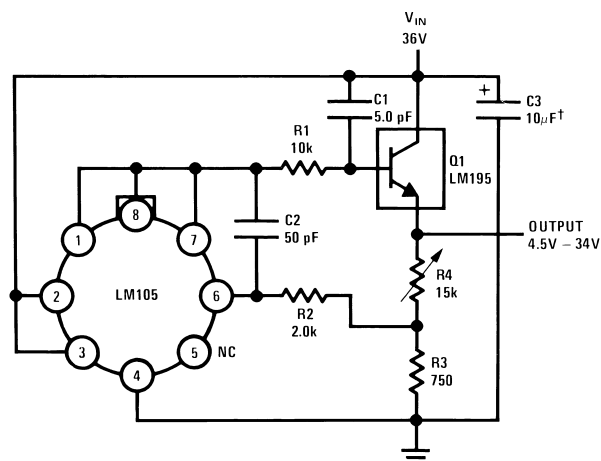


### 1.0 Amp Negative Regulator



†Solid Tantalum

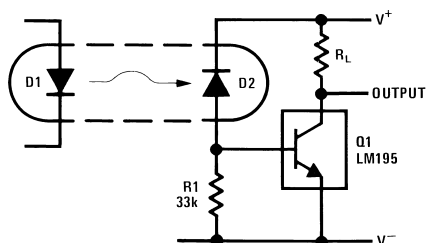
### 1.0 Amp Positive Voltage Regulator



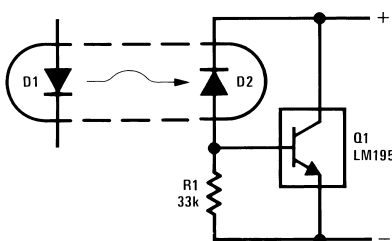
†Solid Tantalum



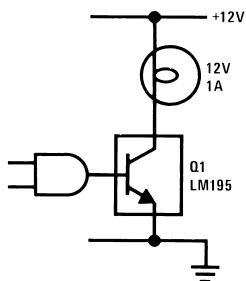
### Fast Optically Isolated Switch



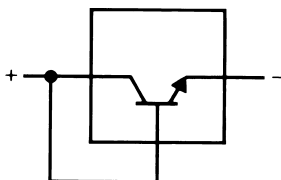
### Optically Isolated Power Transistor



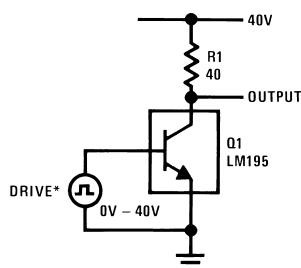
### CMOS or TTL Lamp Interface



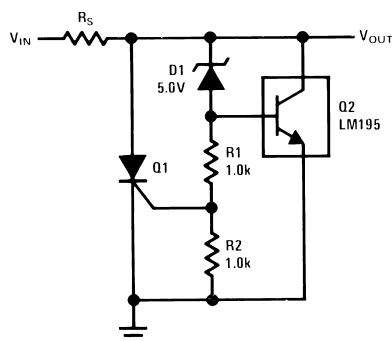
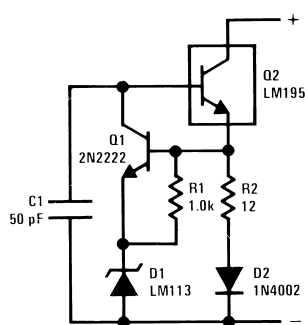
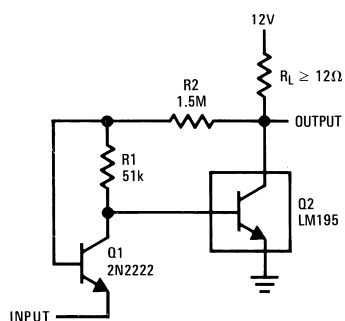
### Two Terminal Current Limiter



### 40V Switch

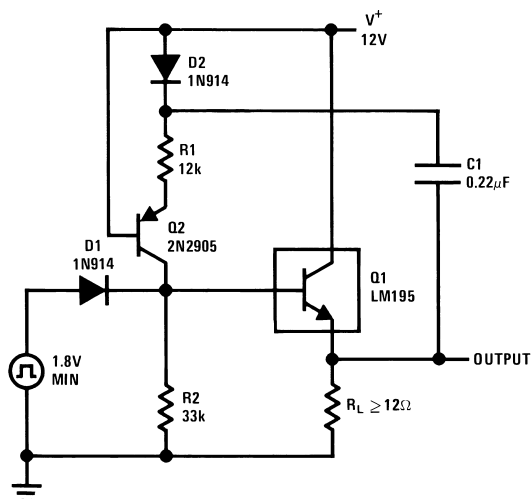


\*Drive Voltage 0V to  $\geq 10V \leq 42V$

**6.0V Shunt Regulator with Crowbar****Two Terminal 100 mA Current Regulator****Low Level Power Switch**

Turn ON = 350 mV  
Turn OFF = 200 mV

### Power One-Shot

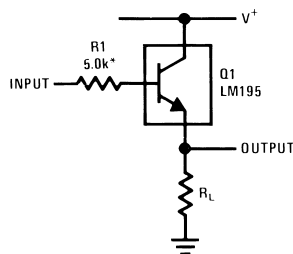


$$T = R1C$$

$$R2 = 3R1$$

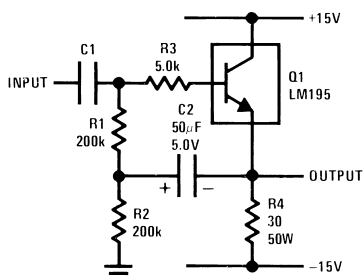
$$R2 \leq 82k$$

### Emitter Follower

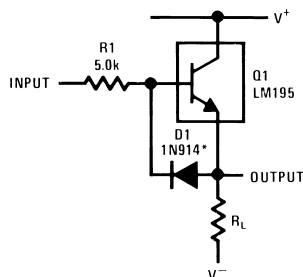


\*Need for Stability

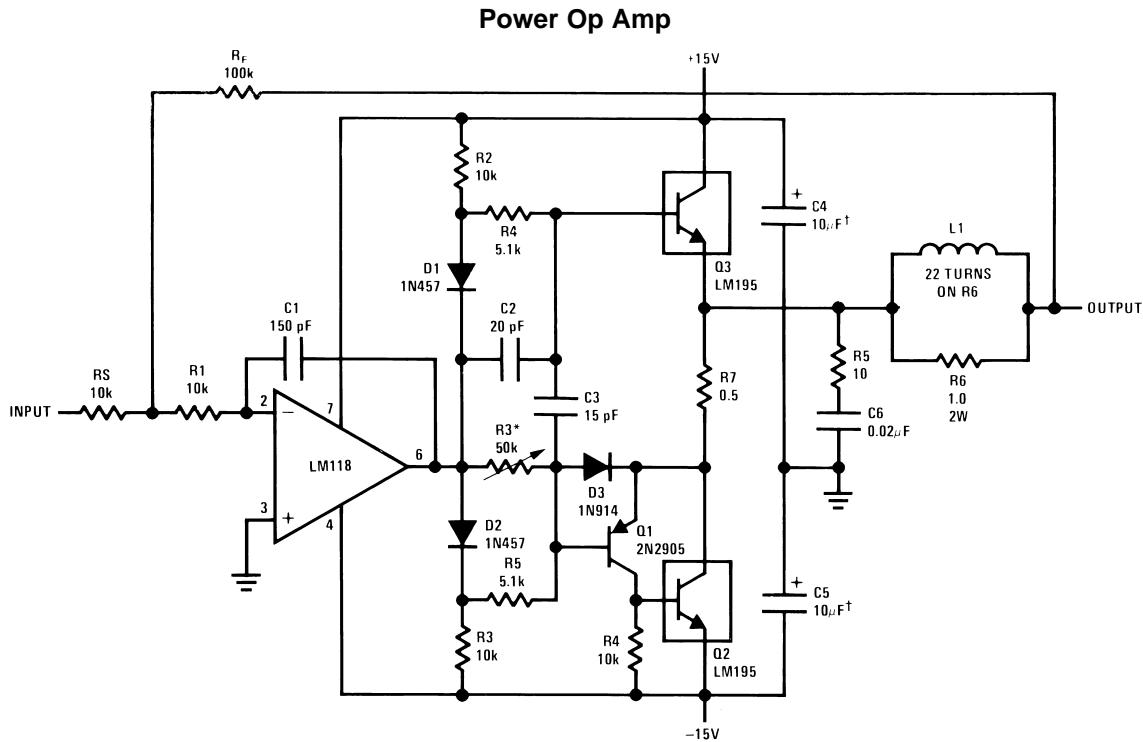
### High Input Impedance AC Emitter Follower



### Fast Follower

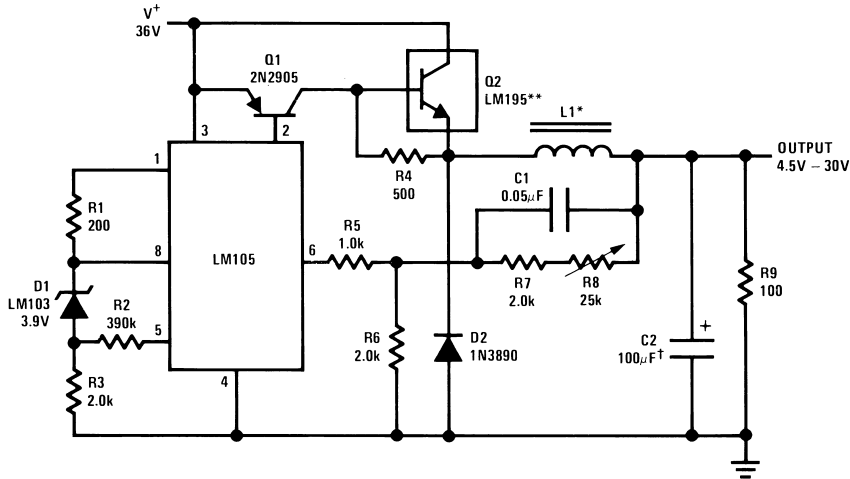


\*Prevents storage with fast fall time square wave drive



\*Adjust for 50 mA quiescent current  
†Solid Tantalum

**6.0 Amp Variable Output Switching Regulator**



\*Sixty turns wound on Arnold Type A-083081-2 core.  
\*\*Four devices in parallel  
†Solid tantalum

**REVISION HISTORY SECTION**

Released	Revision	Section	Changes
11/30/2010	A	New Release, Corporate format	1 MDS data sheets converted into one Corp. data sheet format. MNLM195-H Rev 0BL will be archived.
03/20/2013	A	All	Changed layout of National Data Sheet to TI format

## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
5962-8777801XA	ACTIVE	TO	NDT	3	20	TBD	Call TI	Call TI	-55 to 125	LM195H/883 5962-8777801XA Q A CO 5962-8777801XA Q > T	<a href="#">Samples</a>
LM195H/883	ACTIVE	TO	NDT	3	20	TBD	Call TI	Call TI	-55 to 125	LM195H/883 5962-8777801XA Q A CO 5962-8777801XA Q > T	<a href="#">Samples</a>

(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)

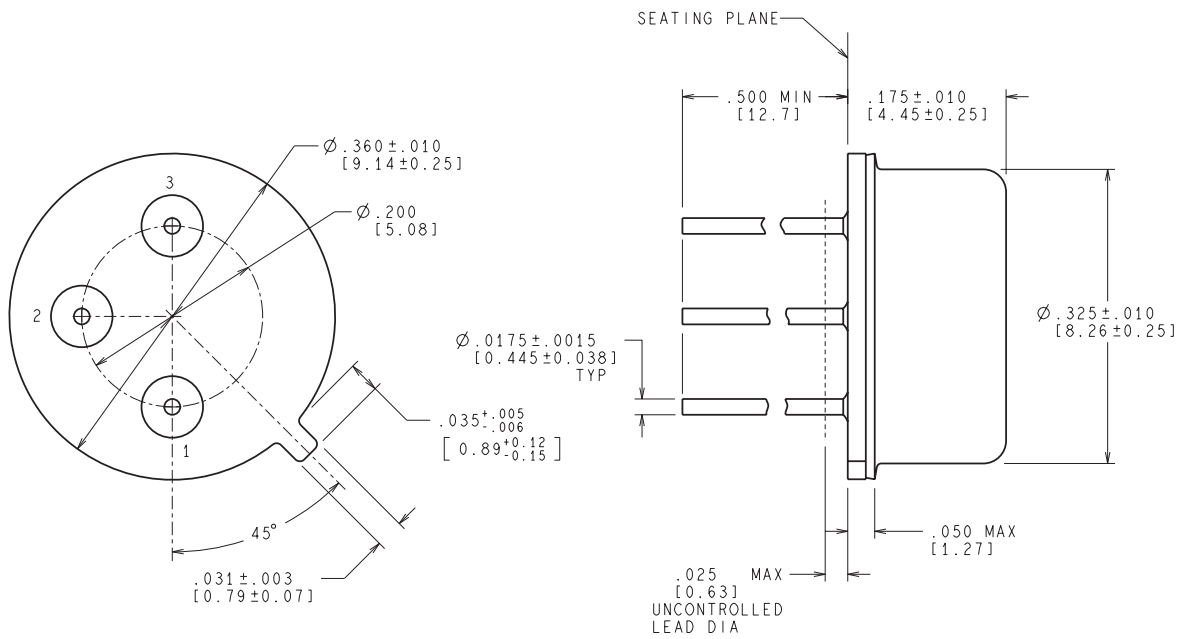
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

NDT0003A



CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS

MIL-PRF-38535  
CONFIGURATION CONTROL

H03A (Rev D)

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)