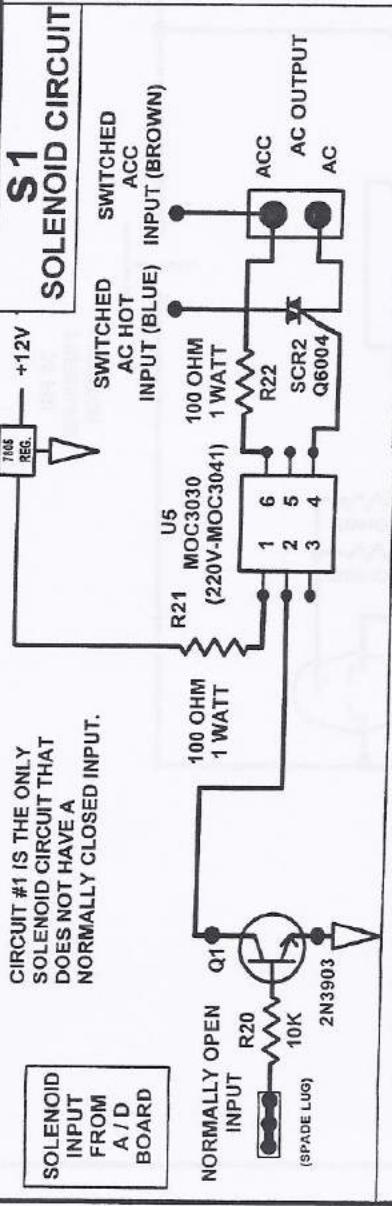


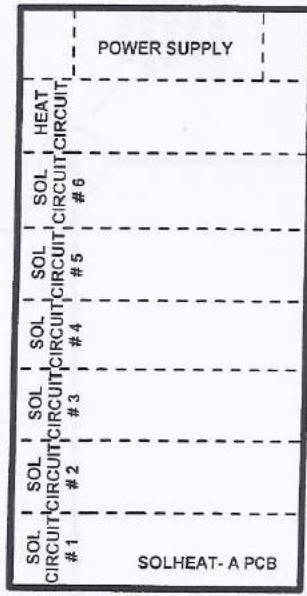
CIRCUIT #1 IS THE ONLY SOLENOID CIRCUIT THAT DOES NOT HAVE A NORMALLY CLOSED INPUT.

SOLENOID INPUT FROM A/D BOARD



S1 SOLENOID CIRCUIT

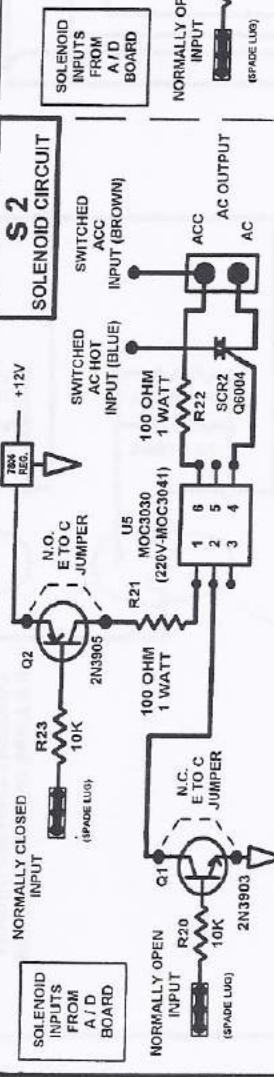
SOLHEAT-A CIRCUIT BOARD LAYOUT



POWER SUPPLY

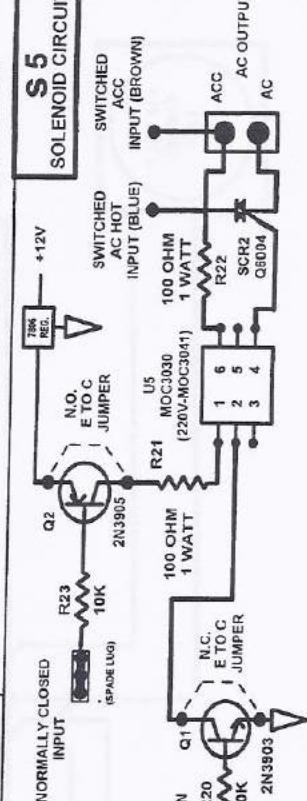
SOLHEAT-A PCB

S2 SOLENOID CIRCUIT

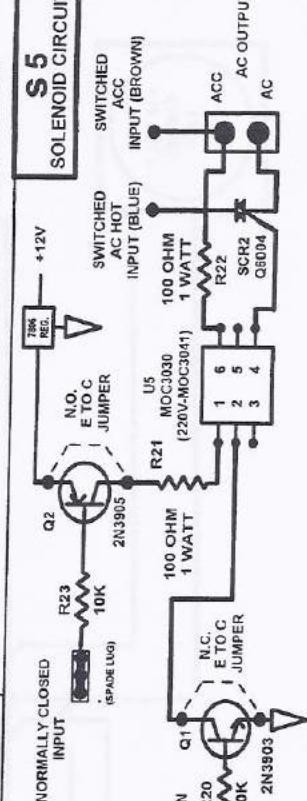


SOLENOID CIRCUIT

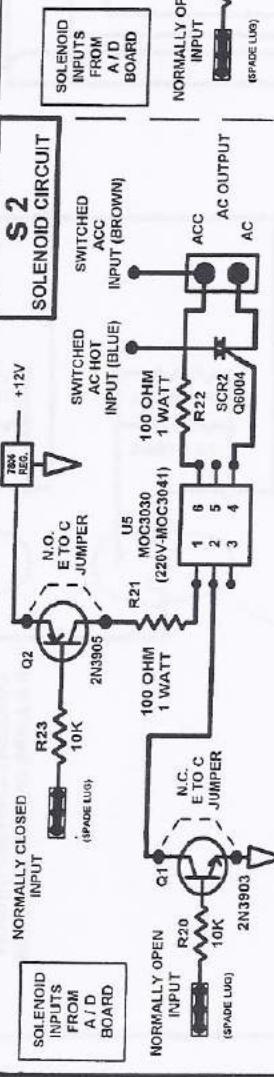
S5 SOLENOID CIRCUIT



S6 SOLENOID CIRCUIT

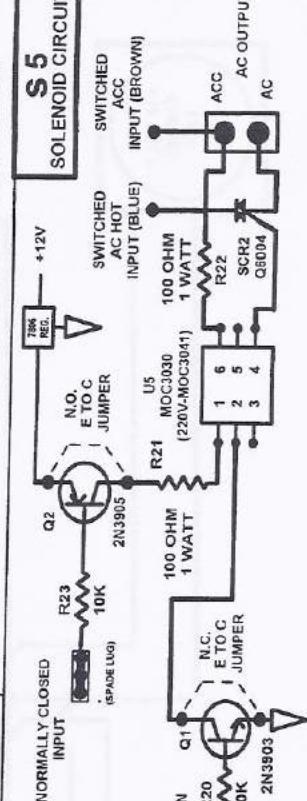


S3 SOLENOID CIRCUIT



SOLENOID CIRCUIT

S4 SOLENOID CIRCUIT



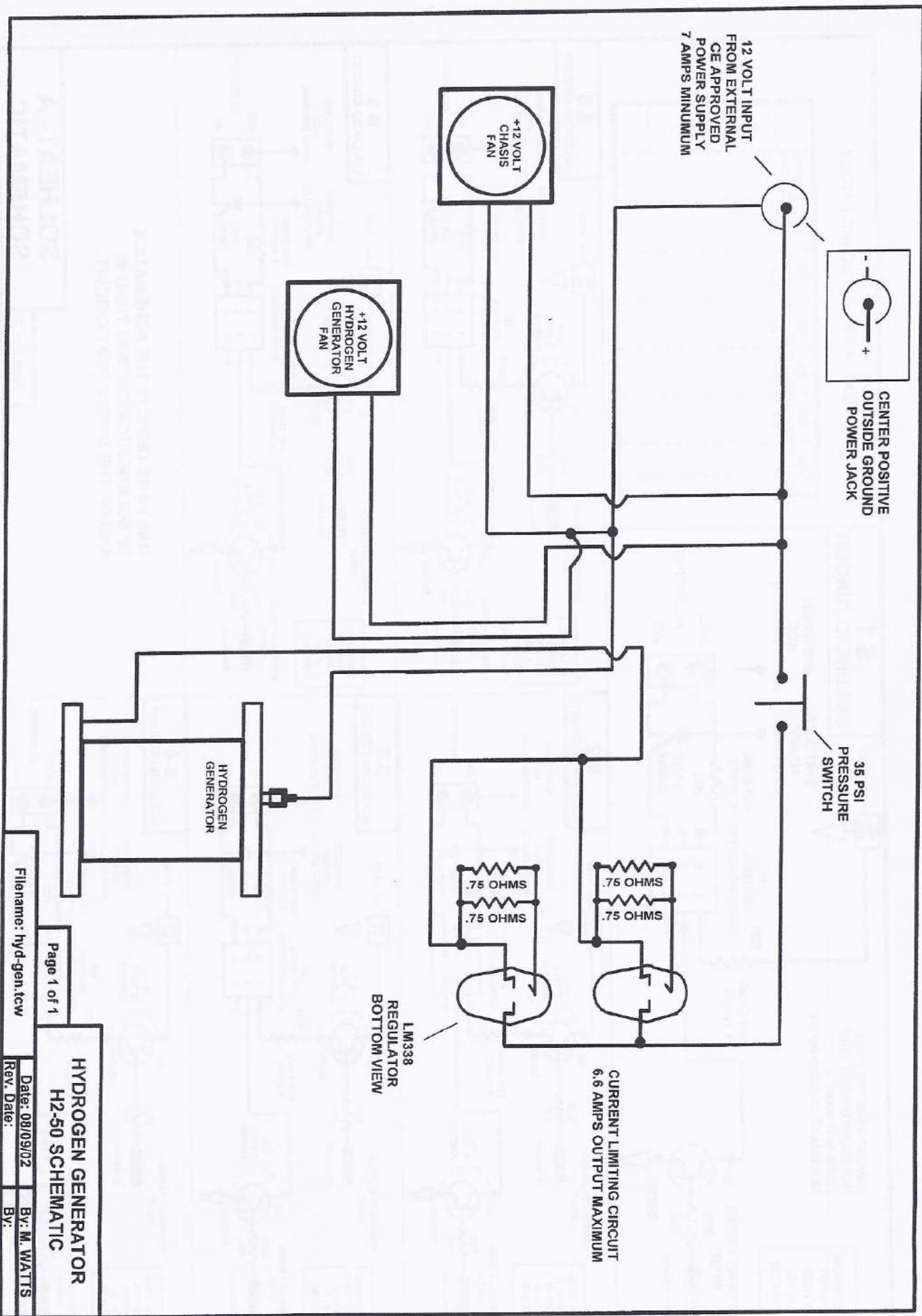
THIS PAGE DEPICTS THE SCHEMATICS OF SOLENOID CIRCUITS #1 THRU #6 AND OF THE SINGLE HEAT CIRCUIT.

SOLHEAT-A SCHEMATIC

Page 2 of 2

Filename: solheat-a pg2.tcw Date: 2/14/00 Rev. Date: 3/15/01 By: R.PFEIFER

HYDROGEN GENERATOR STANDALONE - H2-50





Thermocouple Conditioner and Set-Point Controller

AD596*/AD597*

FEATURES

Low Cost

Operates with Type J (AD596) or Type K (AD597) Thermocouples

Built-in Ice Point Compensation

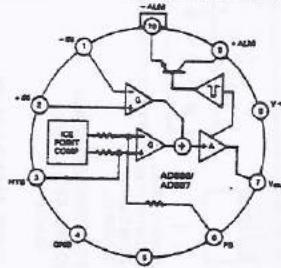
Temperature Proportional Operation - 10mV°C

Temperature Set-Point Operation - ON/OFF

Programmable Switching Hysteresis

High Impedance Differential Input

AD596/AD597 FUNCTIONAL BLOCK DIAGRAM



8

PRODUCT DESCRIPTION

The AD596/AD597 is a monolithic temperature set-point controller which has been optimized for use at elevated temperatures such as those found in oven control applications. The device cold junction compensates and amplifies a type J or K thermocouple input to derive an internal signal proportional to temperature. The internal signal is then compared with an externally applied set-point voltage to yield a low impedance switched output voltage. Dead-Band or switching hysteresis can be programmed using a single external resistor. Alternately, the AD596/AD597 can be configured to provide a voltage output (10mV°C) directly from a type J or K thermocouple signal. It can also be used as a stand-alone voltage output temperature sensor.

The AD596/AD597 can be powered with a single supply from +5V to +30V, or dual supplies up to a total span of 36V. Typical quiescent supply current is 160 μ A which minimizes self-heating errors.

The AD596/AD597 includes a thermocouple failure alarm that indicates an open thermocouple lead when operated in the temperature proportional measurement mode. The alarm output has a flexible format which can be used to drive relays, LEDs or TTL logic.

The device is packaged in a reliability qualified, cost effective 10-pin metal can and is trimmed to operate over an ambient temperature range from +25°C to +100°C. Operation over an extended ambient temperature range is possible with slightly reduced accuracy. The AD596 will amplify thermocouple signals covering the entire -200°C to +760°C temperature range recommended for type J thermocouples while the AD597 can accommodate -200°C to +1250°C type K inputs.

The AD596/AD597 has a calibration accuracy of $\pm 4^\circ\text{C}$ at an ambient temperature of 60°C and an ambient temperature stability specification of 0.05°C/°C from +25°C to +100°C. If higher accuracy, or a lower ambient operating temperature is required, either the AD594 (J thermocouple) or AD595 (K thermocouple) should be considered.

PRODUCT HIGHLIGHTS

1. The AD596/AD597 provides cold junction compensation and a high gain amplifier which can be used as a set-point comparator.
2. The input stage of the AD596/AD597 is a high quality instrumentation amplifier that allows the thermocouple to float over most of the supply voltage range.
3. Linearization not required for thermocouple temperatures close to 175°C (+100°C to +540°C for AD596).
4. Cold junction compensation is optimized for ambient temperatures ranging from +25°C to +100°C.
5. In the stand-alone mode, the AD596/AD597 produces an output voltage that indicates its own temperature.

*Protected by U.S. Patent No. 4,029,974.

FEATURES

- Ultra-Low Bias Current:

150 femtoamps Typ	at +25°C
300 femtoamps Typ	at +85°C
500 femtoamps Typ	at +125°C
- True Single Supply Operation
 - Common-Mode Range Includes Ground
 - Output Swings to Within 200 μ V of Ground Without Pulldown Resistors
- Low Supply Current 325 μ A Max
- Lower Cost Alternative to ADS49 and OPA128
- Low Cost
- Inputs Protected Against 700V of Static Discharge
- Available in Die Form

APPLICATIONS

- Electrometer Amplifier Input Stage
- Photodiode and Infrared Detector Preamplifier
- Chemical and Gas Analyzers
- pH Probe Buffer Amplifier
- Fire Detectors
- High Voltage Voltmeters
- Charge Amplifiers

GENERAL DESCRIPTION

The OP-80 is a low cost CMOS operational amplifier offering exceptionally low input currents over a wide operating tempera-

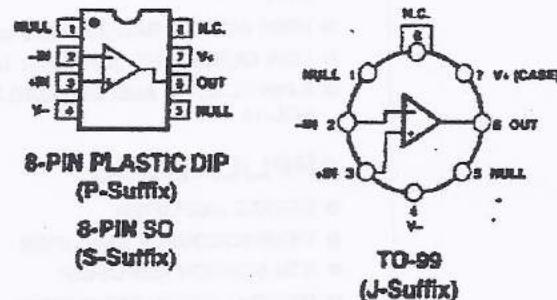
ture range. Input current is typically 150 femtoamps at 25°C and increases to only 300 femtoamps at +85°C, with exceptionally high common-mode and differential input impedances. Incorporating a novel input protection design, the OP-80 achieves over 700V of ESD protection while maintaining very low input current.

For systems demanding both high performance at low supply voltages and high input impedances, the OP-80 is a powerful design tool. It is ideal for use in electrometers, portable medical instrumentation, chemical analyzers, smoke detectors, and sensitive current-to-voltage conversion circuits for photodiodes.

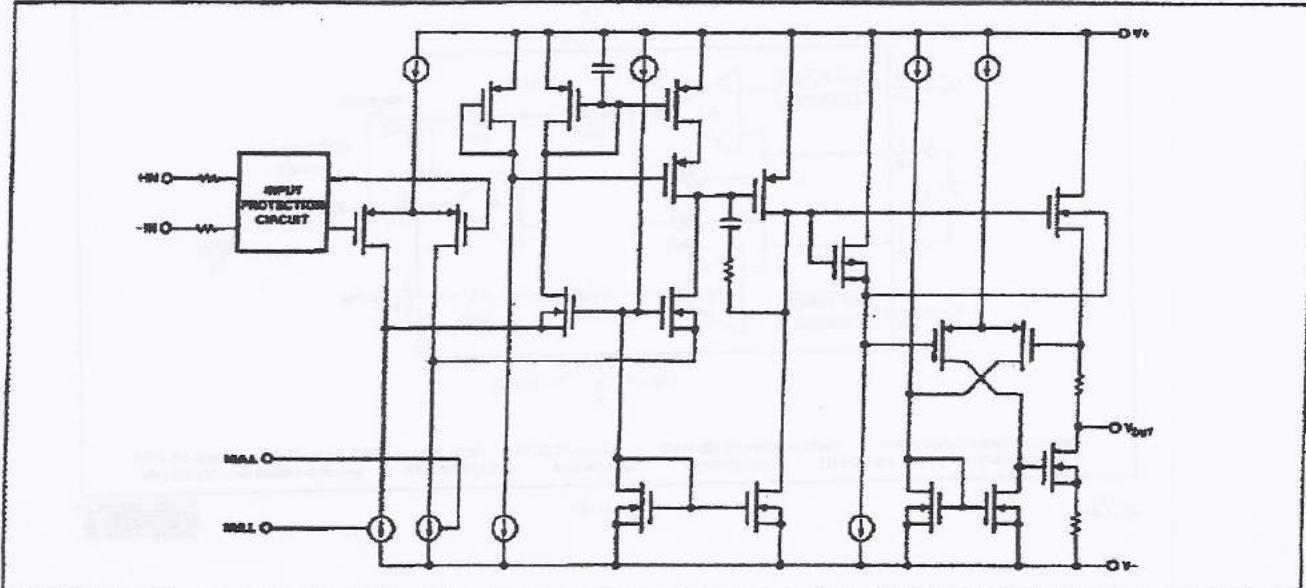
The low supply current minimizes thermal power dissipation, virtually eliminating the effects of chip self-heating. The OP-80's CMOS design gives a good speed/power ratio, permitting a

Continued

PIN CONNECTIONS



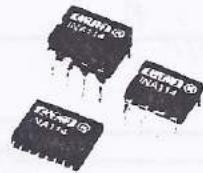
SIMPLIFIED SCHEMATIC



For Immediate Assistance, Contact Your Local Salesperson



INA114



Precision INSTRUMENTATION AMPLIFIER

FEATURES

- LOW OFFSET VOLTAGE: $50\mu\text{V}$ max
 - LOW DRIFT: $0.25\mu\text{V}/^\circ\text{C}$ max
 - LOW INPUT BIAS CURRENT: 2nA max
 - HIGH COMMON-MODE REJECTION: 115dB min
 - INPUT OVER-VOLTAGE PROTECTION: $\pm 40\text{V}$
 - WIDE SUPPLY RANGE: ± 2.25 to $\pm 18\text{V}$
 - LOW QUIESCENT CURRENT: 3mA max
 - 8-PIN PLASTIC AND CERAMIC DIP,
SOL-16

APPLICATIONS

- BRIDGE AMPLIFIER
 - THERMOCOUPLE AMPLIFIER
 - RTD SENSOR AMPLIFIER
 - MEDICAL INSTRUMENTATION
 - DATA ACQUISITION

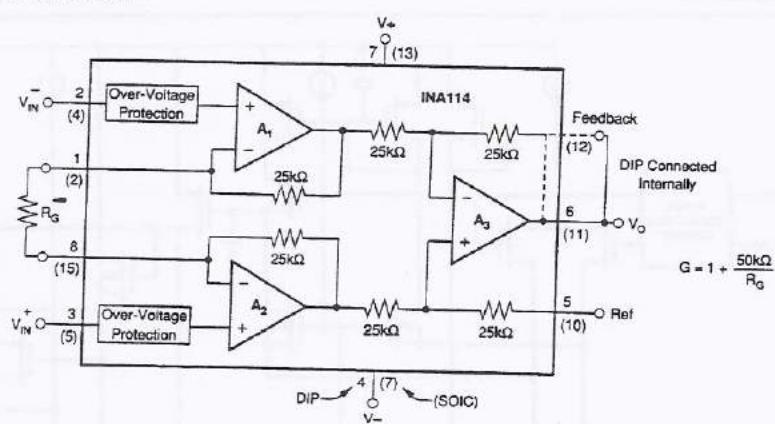
DESCRIPTION

The INA114 is a low cost, general purpose instrumentation amplifier offering excellent accuracy. Its versatile 3-op amp design and small size make it ideal for a wide range of applications.

A single external resistor sets any gain from 1 to 10,000. Internal input protection can withstand up to $\pm 40V$ without damage.

The INA114 is laser trimmed for very low offset voltage ($50\text{ }\mu\text{V}$), drift ($0.25\text{ }\mu\text{V}/^\circ\text{C}$) and high common-mode rejection (115dB at $G = 1000$). It operates with power supplies as low as $\pm 2.25\text{ V}$, allowing use in battery operated and single 5V supply systems. Quiescent current is 3mA maximum.

The INA114 is available in 8-pin plastic and ceramic DIPs, and SOL-16 surface-mount packages, specified for the -40°C to $+85^{\circ}\text{C}$ temperature range.



International Airport Industrial Park • Mailing Address: PO Box 11400 • Tucson, AZ 85734 • Street Address: 6730 S. Tucson Blvd. • Tucson, AZ 85706
Tel: (602) 745-1111 • Twx: 910-952-1111 • Cable: BBRCCORP • Tele: 066-6491 • FAX: (520) 888-1510 • Immediate Product Info: 1-800-541-3424

For Immediate Assistance, Contact Your Local Salesperson



INA117

High Common-Mode Voltage DIFFERENCE AMPLIFIER

FEATURES

- COMMON-MODE INPUT RANGE:
 $\pm 200V$ ($V_s = \pm 15V$)
- PROTECTED INPUTS:
 $\pm 500V$ Common-Mode
 $\pm 500V$ Differential
- UNITY GAIN: 0.02% Gain Error max
- NONLINEARITY: 0.001% max
- CMRR: 86dB min

APPLICATIONS

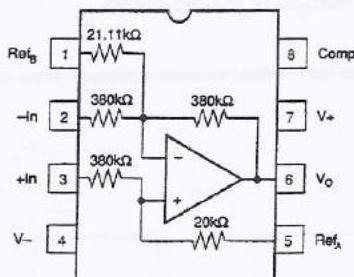
- CURRENT MONITOR
- BATTERY CELL-VOLTAGE MONITOR
- GROUND BREAKER
- INPUT PROTECTION
- SIGNAL ACQUISITION IN NOISY ENVIRONMENTS
- FACTORY AUTOMATION

DESCRIPTION

The INA117 is a precision unity-gain difference amplifier with very high common-mode input voltage range. It is a single monolithic IC consisting of a precision op amp and integrated thin-film resistor network. It can accurately measure small differential voltages in the presence of common-mode signals up to $\pm 200V$. The INA117 inputs are protected from momentary common-mode or differential overloads up to $\pm 500V$.

In many applications, where galvanic isolation is not essential, the INA117 can replace isolation amplifiers. This can eliminate costly isolated input-side power supplies and their associated ripple, noise and quiescent current. The INA117's 0.001% nonlinearity and 200kHz bandwidth are superior to those of conventional isolation amplifiers.

The INA117 is available in 8-pin plastic mini-DIP and SO-8 surface-mount packages, specified for the 0°C to +70°C temperature range. The metal TO-99 models are available specified for the -25°C to +85°C and -55°C to +125°C temperature range.



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Tel: (602) 745-1111 • Twx: 910-952-1111 • Cable: BBRCORP • Telex: 066-6491 • FAX: (602) 699-1510 • Immediate Product Info: (800) 543-6132

FEATURES

- Very small, ideal for thru/behind the panel or PC board mounting
- Full size (0.56") digit height
- Packaged in a 12-pin plastic DIP, with a color filter case (0.9" H x 2.1" W x 0.5" D)
- Available in many bright LED colors: red, orange, amber, yellow, green, blue, and aqua
- Super bright versions available
- Low power 50mW models available
- Differential inputs with optional ranges of ± 200 mV, ± 2 V, and ± 20 V dc
- Factory calibrated to within ± 1 count, no external adjustments necessary
- Autozero A/D converter for long term stability with no adjustments
- A +5V supply is the only power required
- "Display Test" pin available
- User-selectable decimal point placement
- Fully encapsulated package well suited for harsh environments
- Many optional support products to cover virtually all possible applications
- Installation tools for easy prototyping available: cut-out punch, retaining clip inserter, evaluation board

GENERAL DESCRIPTION

The DMS-30PC Series is a line of fully operational, self-contained and complete 3 1/2 digit voltmeters. The very small size of these digital voltmeters has been achieved by integrating the display and converter circuitry into one assembly, using the most modern microelectronic hybrid packaging techniques.

The result is a very small and solid digital voltmeter which can be handled like a component unlike awkward PC boards or conventional meters housed in plastic boxes.



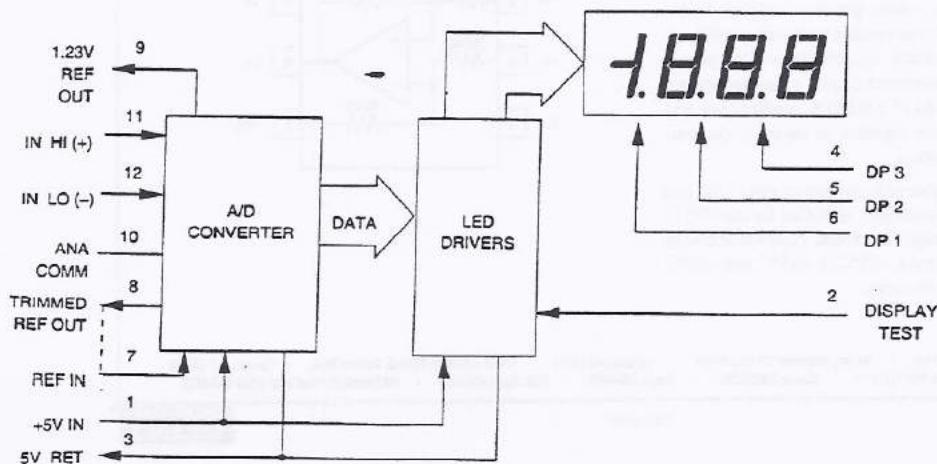
CMR to 86 dB, high impedance, differential input, overvoltage protection (to ± 250 V dc), and a built-in, high stability, double regulated reference circuit allows for extreme accuracy (0.05%, ± 1 digit), repeatability and a very long MTBF.

The large (0.56") 3 1/2 digit LED display is available in a wide variety of colors including; red, orange, amber, yellow, green, and blue to suit every application. The DMS-30PC Series meters are available in three voltage input ranges: ± 200 mV (DMS-30PC-0), ± 2 V dc (DMS-30PC-1), and ± 20 V dc (DMS-30PC-2).

Input impedances are 1,000 megohms for both the ± 200 mV and ± 2 V dc models and 1 megohm for the ± 20 V dc model, minimizing circuit loading. A single +5V dc supply (no other parts required) makes the DMS-30PC Series fully operational over a very broad temperature range of 0 to +60 °C.

The DMS-30PC Series is ideal for high performance, high reliability measurement systems where low cost and ease of use are paramount.

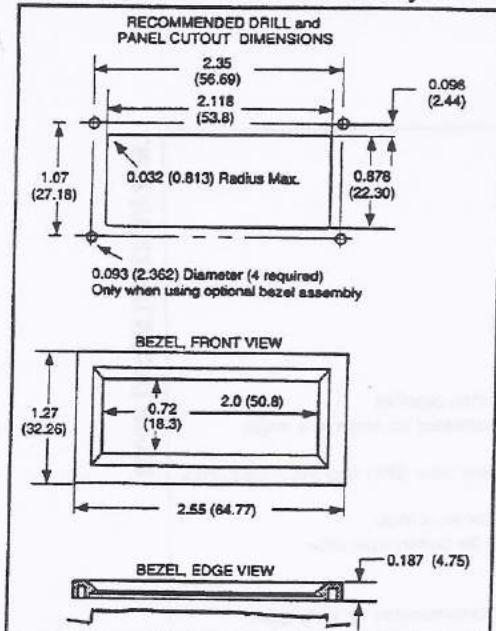
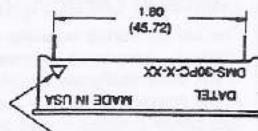
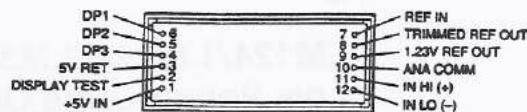
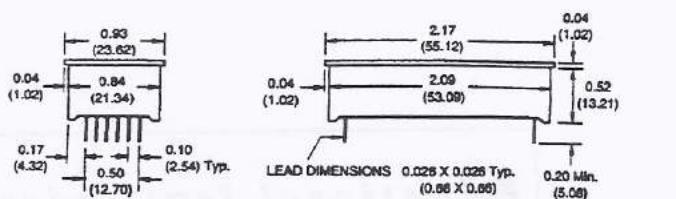
The built-in bezel, low power drain, fully encapsulated (plastic) case, and small footprint with large LED display were designed for direct pc board mounting, panel mount application, and mobile/portable instrumentation.



APPLICATIONS

- Board-level diagnostics
- Weigh scales
- Automatic test equipment
- Avionics displays
- Lab/test equipment
- Digital thermometers
- Harsh environment usage
- Process monitoring
- Portable/mobile instruments

Figure 1. DMS-30PC Simplified Block Diagram

**Panel Cutout Dimensions and
Optional Bezel Assembly**

MECHANICAL DIMENSIONS


Recommended printed circuit board finished hole diameter is 0.042 (1.067), ± 0.002 (0.051)

Tolerances Unless
Otherwise Specified

2 Decimal Places ± 0.02 (± 0.50)
3 Decimal Places ± 0.010 (± 0.254)

Mounting Clip
ORDERING INFORMATION
DMS-30PC-X-XX

INPUT RANGE

0 = +200mV
1 = $\pm 2V$
2 = $\pm 20V$

LED COLOR

YS = Yellow
OS = Orange
AS = Amber
BS = Blue
RS = Red
GS = Green
QS = Aqua
RH = High Intensity Red
RL = Low Power Red
GL = Low Power Green
OL = Low Power Orange

ACCESSORIES

RN-DMS

Gain/Offset potentiometer kit for DMS-EB,
DMS-EB-AC/DC, and DMS-EB-DC/DC (see below)

DMS-30-CP Panel cutout punch

DMS-30-BZL1 DMS-30 Bezel Assembly

DMS-30-BZL2 DMS-30 Bezel Assembly with NEMA 4 gasket

ADD-ON APPLICATION BOARDS

DMS-EB

Multipurpose (4-20mA, gain/offset adjust)
High accuracy temperature probe sensing for

DMS-EB-HTB 200mV models

Provides isolated +5V power

DMS-EB-DC/DC

J-type thermocouple inputs for $\pm 2V$ models

DMS-EB-TCJ

K-type thermocouple inputs for $\pm 2V$ models

DMS-EB-TCK

For true RMS measurements of AC voltages

DMS-EB-RMS

For AC line-powered applications

DMS-EB-AC/DC

For 4-20mA loop-powered applications

DMS-EB-LP

DATEL makes no representation that the use of these products in the circuits described herein, or use of other technical information contained herein, will not infringe upon existing or future patent rights nor do the descriptions contained herein imply the granting of licenses to make, use, or sell equipment constructed in accordance therewith. Specifications subject to change without notice.



National Semiconductor

LM124/LM224/LM324/LM2902 Low Power Quad Operational Amplifiers

General Description

The LM124 series consists of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, DC gain blocks and all the conventional op amp circuits which now can be more easily implemented in single power supply systems. For example, the LM124 series can be directly operated off of the standard +5V power supply voltage which is used in digital systems and will easily provide the required interface electronics without requiring the additional $\pm 15V$ power supplies.

Unique Characteristics

- In the linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage
- The unity gain cross frequency is temperature compensated
- The input bias current is also temperature compensated

Advantages

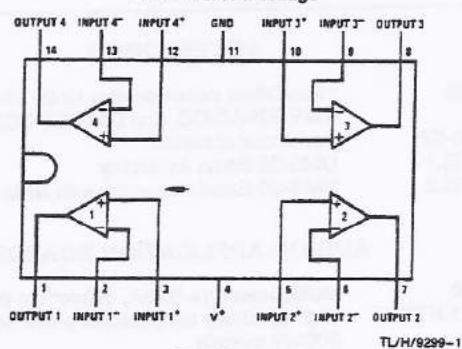
- Eliminates need for dual supplies
- Four internally compensated op amps in a single package
- Allows directly sensing near GND and V_{OUT} also goes to GND
- Compatible with all forms of logic
- Power drain suitable for battery operation

Features

- | | |
|--|--------------------------------------|
| ■ Internally frequency compensated for unity gain | 100 dB |
| ■ Large DC voltage gain | 1 MHz |
| ■ Wide bandwidth (unity gain)
(temperature compensated) | |
| ■ Wide power supply range:
Single supply or dual supplies | 3V to 32V
$\pm 1.5V$ to $\pm 16V$ |
| ■ Very low supply current drain ($700\ \mu A$)—essentially independent of supply voltage | |
| ■ Low input biasing current
(temperature compensated) | 45 nA |
| ■ Low input offset voltage and offset current | 2 mV
5 nA |
| ■ Input common-mode voltage range includes ground | |
| ■ Differential input voltage range equal to the power supply voltage | |
| ■ Large output voltage swing | 0V to V ⁺ - 1.5V |

Connection Diagram

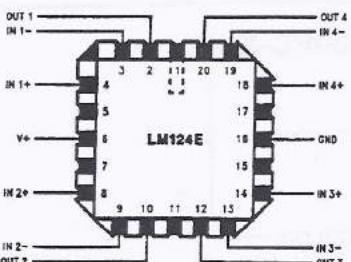
Dual-In-Line Package



TL/H/9299-1

Top View

Order Number LM124J, LM124AJ, LM124J/883*,
LM124AJ/883*, LM224J, LM224AJ, LM324J, LM324M,
LM324AM, LM2902M, LM324N, LM324AN or LM2902N
See NS Package Number J14A, M14A or N14A



Order Number LM124AE/883 or LM124E/883
See NS Package Number E20A



TL/H/9299-33

Order Number LM124AW/883 or LM124W/883
See NS Package Number W14B

*LM124A available per JM38510/11006
**LM124 available per JM38510/11005



National Semiconductor

LF155/LF156/LF157 Series Monolithic JFET Input Operational Amplifiers

LF155/LF156/LF157

General Description

These are the first monolithic JFET input operational amplifiers to incorporate well matched, high voltage JFETs on the same chip with standard bipolar transistors (BI-FET™ Technology). These amplifiers feature low input bias and offset currents/low offset voltage and offset voltage drift, coupled with offset adjust which does not degrade drift or common-mode rejection. The devices are also designed for high slew rate, wide bandwidth, extremely fast settling time, low voltage and current noise and a low 1/f noise corner.

Advantages

- Replace expensive hybrid and module FET op amps
- Rugged JFETs allow blow-out free handling compared with MOSFET input devices
- Excellent for low noise applications using either high or low source impedance—very low 1/f corner
- Offset adjust does not degrade drift or common-mode rejection as in most monolithic amplifiers
- New output stage allows use of large capacitive loads (5,000 pF) without stability problems
- Internal compensation and large differential input voltage capability

Applications

- Precision high speed integrators
- Fast D/A and A/D converters
- High impedance buffers
- Wideband, low noise, low drift amplifiers
- Logarithmic amplifiers

- Photocell amplifiers
- Sample and Hold circuits

Common Features

(LF155A, LF156A, LF157A)

■ Low input bias current	30 pA
■ Low Input Offset Current	3 pA
■ High input impedance	10 ¹² Ω
■ Low input offset voltage	1 mV
■ Low input offset voltage temp. drift	3 μV/°C
■ Low input noise current	0.01 pA/√Hz
■ High common-mode rejection ratio	100 dB
■ Large dc voltage gain	106 dB

Uncommon Features

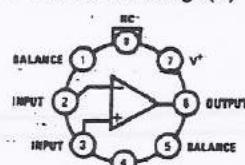
	LF155A	LF156A	LF157A (Av=5)	Units
■ Extremely fast settling time to 0.01%	4	1.5	1.5	μs
■ Fast slew rate	5	12	50	V/μs
■ Wide gain bandwidth	2.5	5	20	MHz
■ Low input noise voltage	20	12	12	nV/√Hz

*C = 3 pF in LF157 series.

TL/H/5646-13

Connection Diagrams (Top Views)

Metal Can Package (H)

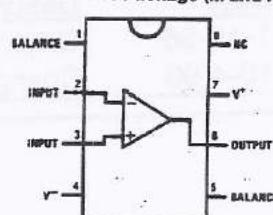


TL/H/5646-14

Order Number LF156AH, LF155H, LF156H, LF255H,
LF256H, LF257H, LF355AH, LF356AH,
LF357AH, LF356BH, LF355H, LF356H,
LF357H, LM155AH/883, LM155H/883, LM156AH/883,
LM156H/883, LM157AH/883 or LM157H/883*

See NS Package Number H08C

Dual-In-Line Package (M and N)



TL/H/5646-29

Order Number LF355M, LF356M, LF357M, LF355BM,
LF356BM, LF355BN, LF356BN, LF357BN, LF355N,
LF356N or LF357N

See NS Package Number M08A or N08E

SCC100GS/SZ75400

Special 0 to 100 psig Pressure Sensors for SRI

Preliminary 1/15/96

General Description

The SCC series sensors offer an extremely low cost sensor element with a temperature stable output when driven with a constant current source. These integrated circuit sensors were designed for extremely cost sensitive applications where precise accuracy over a wide temperature range is not required. This part features a protective polyimide coating over the sensor element. However, this device type is intended for use with non-corrosive, non-ionic working fluids such as air, dry gases, and the like.

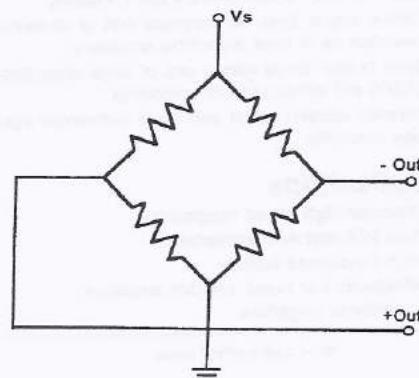
The SZ75400 special for SRI is different than the standard SCC100GS in that it has a special long tube attached for pressure connection. All else is per the standard specifications for the SCC100GS product.

Contact your local SenSym representative or the SenSym factory for additional details.

Features

- Low Cost
- Internal Temperature Compensation
- Small Size
- Gage Pressure
- Reliable Semiconductor Technology

Closed Circuit



Applications

- Special Sensors for SRI

Revision History

<u>Revision</u>	<u>Date</u>	<u>Description</u>
0	1-15-96	Original Specification
1	10-4-96	Change to Closed Bridge

Drawing Approvals

SenSym, Inc.:

Printed Name/Title

Signature

Date

SRI:

Printed Name/Title

Signature

Date

Pressure Sensor Characteristics

Environmental Specifications

Temperature Ranges:

Compensated	0°C to +50°C
Operating	-40°C to +85°C
Storage	-55°C to +125°C

Humidity: 0 to 100%RH

Maximum Ratings

Supply Current $I_s = 1.5\text{mA}$

Lead Temperature (Soldering 2 - 4 sec) 250°C

Pressure Range Specifications

SenSym PART NO.	SRI PART NO.	PRESSURE RANGE	PROOF PRESSURE ⁽⁷⁾
SCC100GS/SZ75400		0-100 PSIG	150 PSIG

Performance Characteristics⁽¹⁾

Characteristic	min	typical	max	units
Zero pressure offset (@ $T_A=25^\circ\text{C}$)	-30.0	-10.0	+20.0	mV
Full scale span ⁽²⁾	85	155	225	mV
Linearity, hysteresis & repeatability ⁽³⁾	-0.5	0.1	0.5	%FSO
Temp. effect on span ⁽⁴⁾	-1.5	0.25	1.5	%FSO
Temp. effect on offset ⁽⁴⁾	—	45	90	uV/°C
Long term stability of offset span ⁽⁵⁾	—	0.1	—	%FSO
Response time (10% to 90%) ⁽⁶⁾	—	0.1	—	ms
Input resistance (@ $T_A=25^\circ\text{C}$)	4.0	5.0	6.5	k
Output impedance	4.0	5.0	6.5	k

Specification Notes:

Note 1: Reference Conditions (unless otherwise noted): Supply current, $I_s=1.0\text{ mA}; T_a=25^\circ\text{C}$.

Note 2: Span is the algebraic difference between the output voltage at full scale pressure and the output at zero pressure. Span is ratiometric to the supply voltage.

Note 3: Linearity is based on best fit straight line. Hysteresis is the maximum output difference at any point within the operating pressure range for increasing and decreasing pressure.

Note 4: Maximum error band of the offset voltage and the error of the band of the span over the compensated temperature range, relative to the 25°C reading. Typical temperature coefficients for span and resistance are -2200 ppm/°C respectively.

Temperature effects on offset and span are guaranteed by design. These parameters are not 100% tested in production.

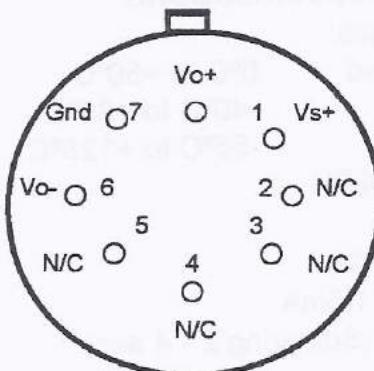
Note 5: Long term stability over a one year period.

Note 6: Response time for 0 psi to full scale span pressure step change

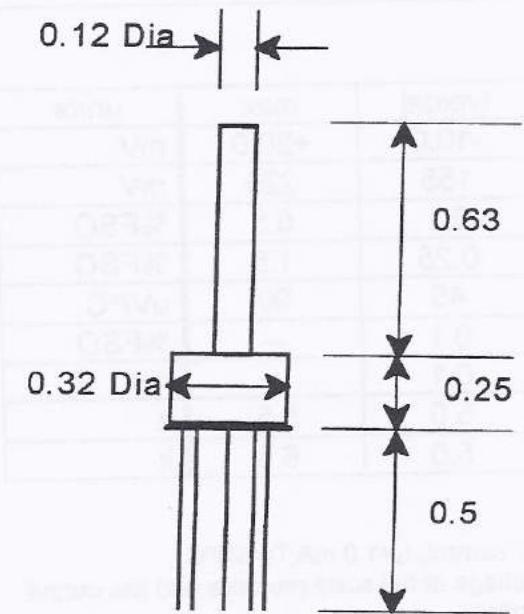
Note 7: If maximum pressure is exceeded, even momentarily, the package may leak or burst, or the pressure sensing die may fracture.

Electrical Connections

Pin	Function
1	Vsupply+
2	N/C
3	N/C
4	N/C
5	N/C
6	-Vout
7	Ground
8	+Vout



Pin Out (Bottom View)

Physical Dimensions (In inches)**Approximate Weight: 1 gram**

SenSym reserves the right to make changes to any products herein. SenSym does not assume any liability arising out of the application or use of any product or circuit described herein, neither does it convey any license under its patent rights nor the right of others.

MOC3031M

MOC3032M

MOC3033M

MOC3041M

MOC3042M

MOC3043M

DESCRIPTION

The MOC303XM and MOC304XM devices consist of a AlGaAs infrared emitting diode optically coupled to a monolithic silicon detector performing the function of a zero voltage crossing bilateral triac driver.

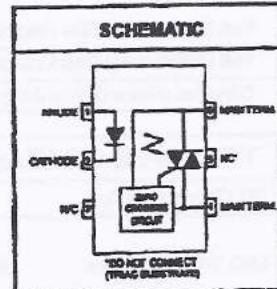
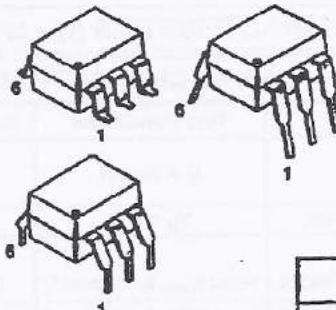
They are designed for use with a triac in the interface of logic systems to equipment powered from 115 VAC lines, such as teletypewriters, CRTs, solid-state relays, industrial controls, printers, motors, solenoids and consumer appliances, etc.

FEATURES

- Simplifies logic control of 115 VAC power
- Zero voltage crossing
- dv/dt of 2000 V/μs typical, 1000 V/μs guaranteed
- VDE recognized (File # 94766)
- ordering option V (e.g., MOC3043VM)

APPLICATIONS

- | | |
|---------------------------|----------------------|
| • Solenoid/valve controls | • Lighting controls |
| • Static power switches | • AC motor drives |
| • Temperature controls | • E.M. contactors |
| • AC motor starters | • Solid state relays |



ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Parameters	Symbol	Device	Value	Units
TOTAL DEVICE				
Storage Temperature	T_{STG}	All	-40 to +150	°C
Operating Temperature	T_{OPR}	All	-40 to +85	°C
Lead Solder Temperature	T_{SOL}	All	260 for 10 sec	°C
Junction Temperature Range	T_J	All	-40 to +100	°C
Isolation Surge Voltage ¹⁾ (peak AC voltage, 60Hz, 1 sec duration)	V_{ISO}	All	7500	Vac(pk)
Total Device Power Dissipation @ 25°C	P_D	All	250	mW
Derate above 25°C			2.84	mW/°C
EMITTER				
Continuous Forward Current	I_F	All	60	mA
Reverse Voltage	V_R	All	5	V
Total Power Dissipation 25°C Ambient	P_D	All	120	mW
Derate above 25°C			1.41	mW/°C
DETECTOR				
Off-State Output Terminal Voltage	V_{DRM}	MOC3031M/2M/3M	250	V
Peak Repetitive Surge Current (PW = 100 μs, 120 pps)		MOC3041M/2M/3M	400	
Total Power Dissipation @ 25°C Ambient	P_D	All	150	mW
Derate above 25°C			1.76	mW/°C

Note

1. Isolation surge voltage, V_{ISO} , is an internal device dielectric breakdown rating. For this test, Pins 1 and 2 are common, and Pins 4, 5 and 6 are common.

MOC3031M MOC3032M MOC3033M MOC3041M MOC3042M MOC3043M

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ Unless otherwise specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

Parameters	Test Conditions	Symbol	Device	Min	Typ	Max	Units
EMITTER							
Input Forward Voltage	$I_F = 30 \text{ mA}$	V_F	All		1.25	1.5	V
Reverse Leakage Current	$V_R = 6 \text{ V}$	I_R	All		0.01	100	μA
DETECTOR							
Peak Blocking Current, Either Direction	Rated V_{DTR} , $I_F = 0$ (note 1)	I_{DTR1}	All			100	nA
Peak On-State Voltage, Either Direction	$I_{TM} = 100 \text{ mA peak}$, $I_F = 0$	V_{TM}	All		1.8	3	V
Critical Rate of Rise of Off-State Voltage	$I_F = 0$ (figure 9, note 3)	dv/dt	All	1000			$\text{V}/\mu\text{s}$

TRANSFER CHARACTERISTICS ($T_A = 25^\circ\text{C}$ Unless otherwise specified.)

DC Characteristics	Test Conditions	Symbol	Device	Min	Typ	Max	Units
LED Trigger Current	Main terminal voltage = 3V (note 2)	I_{FT}	MOC3031M/MOC3041M			15	mA
			MOC3032M/MOC3042M			10	
			MOC3033M/MOC3043M			5	
Holding Current, Either Direction		I_H	All		400		μA

ZERO CROSSING CHARACTERISTICS ($T_A = 25^\circ\text{C}$ Unless otherwise specified.)

Characteristics	Test Conditions	Symbol	Device	Min	Typ	Max	Units
Inhibit Voltage	$I_F = \text{rated } I_{FT}$, MT1-MT2 voltage above which device will not trigger off-state	V_H	All			20	V
Leakage in Inhibited State	$I_F = \text{rated } I_F$, rated V_{DTR} off-state	I_{DTR2}	All			500	μA

Note

1. Test voltage must be applied within dv/dt rating.
2. All devices are guaranteed to trigger at an I_F value less than or equal to max I_{FT} . Therefore, recommended operating I_F lies between max I_{FT} (15 mA for MOC3031M & MOC3041M, 10 mA for MOC3032M & MOC3042M, 5 mA for MOC3033M & MOC3043M) and absolute max I_F (60 mA).
3. This is static dv/dt . See Figure 9 for test circuit. Commutating dv/dt is a function of the load-driving thyristor(s) only.



National
Semiconductor
Corporation

LM35/LM35A/LM35C/LM35CA/LM35D Precision Centigrade Temperature Sensors

General Description

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4^\circ\text{C}$ at room temperature and $\pm 1/4^\circ\text{C}$ over a full -55 to $+150^\circ\text{C}$ temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only $60 \mu\text{A}$ from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a -55 to $+150^\circ\text{C}$ temperature range, while the LM35C is rated for a -40 to $+110^\circ\text{C}$ range (-10° with improved accuracy). The LM35 series is

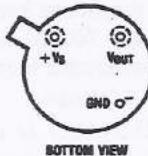
available packaged in hermetic TO-46 transistor packages, while the LM35C is also available in the plastic TO-92 transistor package.

Features

- Calibrated directly in ° Celsius (Centigrade)
- Linear $+ 10.0 \text{ mV}/^\circ\text{C}$ scale factor
- 0.5°C accuracy guaranteed (at $+25^\circ\text{C}$)
- Rated for full -55 to $+150^\circ\text{C}$ range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than $60 \mu\text{A}$ current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only $\pm 1/4^\circ\text{C}$ typical
- Low impedance output, 0.1Ω for 1 mA load

Connection Diagrams

TO-46
Metal Can Package*



TL/H/5516-1

*Case is connected to negative pin

Order Number LM35H, LM35AH,
LM35CH, LM35CAH or LM35DH
See NS Package Number H03H

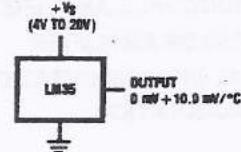
TO-92
Plastic Package



TL/H/5516-2

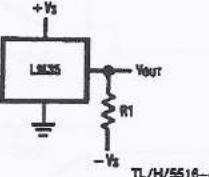
Order Number LM35CZ or LM35DZ
See NS Package Number Z03A

Typical Applications



TL/H/5516-3

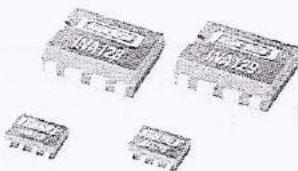
FIGURE 1. Basic Centigrade Temperature Sensor (+2°C to +150°C)



Choose $R_1 = -V_s/50 \mu\text{A}$

$V_{OUT} = +1,500 \text{ mV at } +150^\circ\text{C}$
 $= +250 \text{ mV at } +25^\circ\text{C}$
 $= -550 \text{ mV at } -55^\circ\text{C}$

FIGURE 2. Full-Range Centigrade Temperature Sensor



INA128
INA129

Precision, Low Power INSTRUMENTATION AMPLIFIERS

FEATURES

- LOW OFFSET VOLTAGE: 50 μ V max
- LOW DRIFT: 0.5 μ V/ $^{\circ}$ C max
- LOW INPUT BIAS CURRENT: 5nA max
- HIGH CMR: 120dB min
- INPUTS PROTECTED TO \pm 40V
- WIDE SUPPLY RANGE: \pm 2.25 to \pm 18V
- LOW QUIESCENT CURRENT: 700 μ A
- 8-PIN PLASTIC DIP, SO-8

APPLICATIONS

- BRIDGE AMPLIFIER
- THERMOCOUPLE AMPLIFIER
- RTD SENSOR AMPLIFIER
- MEDICAL INSTRUMENTATION
- DATA ACQUISITION

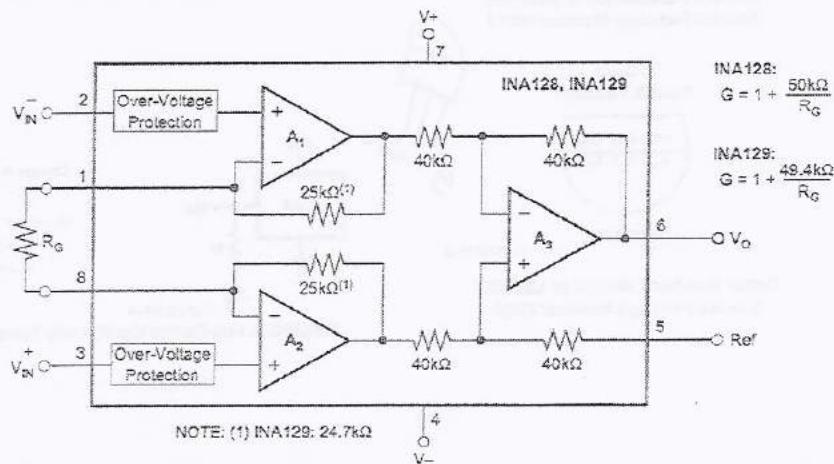
DESCRIPTION

The INA128 and INA129 are low power, general purpose instrumentation amplifiers offering excellent accuracy. Their versatile 3-op amp design and small size make them ideal for a wide range of applications. Current-feedback input circuitry provides wide bandwidth even at high gain (200kHz at G = 100).

A single external resistor sets any gain from 1 to 10,000. INA128 provides an industry standard gain equation; INA129's gain equation is compatible with the AD620.

The INA128/INA129 is laser trimmed for very low offset voltage (50 μ V), drift (0.5 μ V/ $^{\circ}$ C) and high common-mode rejection (120dB at G \geq 100). It operates with power supplies as low as \pm 2.25V, and quiescent current is only 700 μ A—ideal for battery operated systems. Internal input protection can withstand up to \pm 40V without damage.

The INA128/INA129 is available in 8-pin plastic DIP, and SO-8 surface-mount packages, specified for the -40° C to $+85^{\circ}$ C temperature range. The INA128 is also available in dual configuration, the INA218.

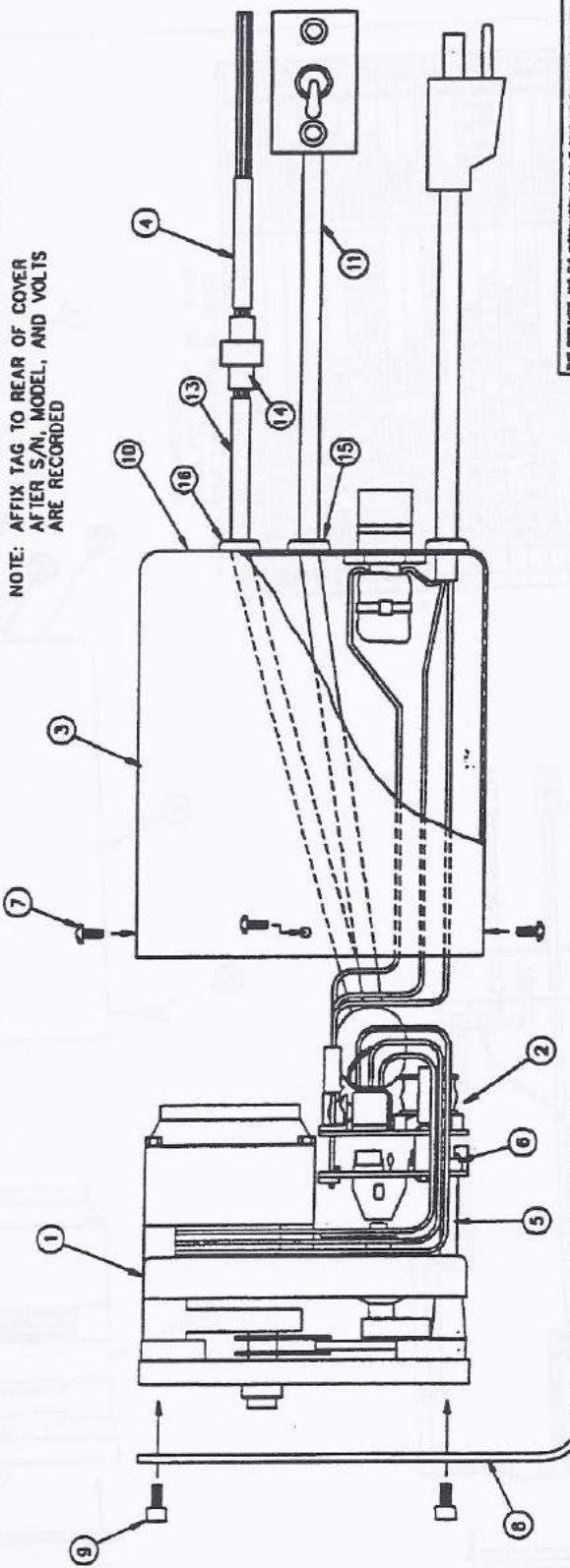
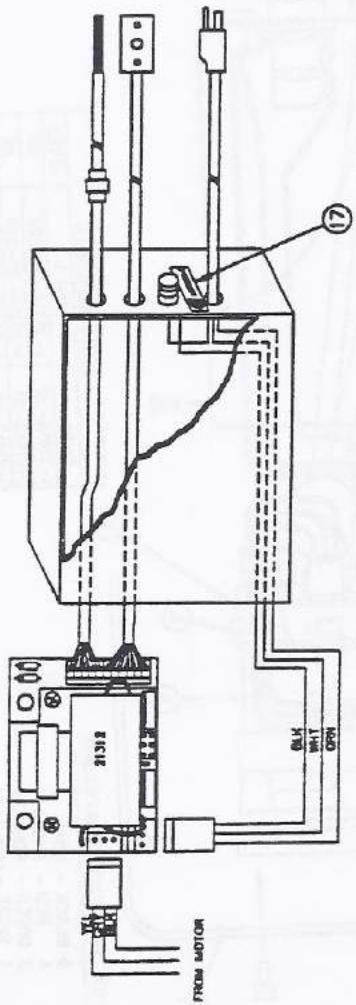


International Airport Industrial Park • Mailing Address: PO Box 11400, Tucson, AZ 85734 • Street Address: 6730 S. Tucson Blvd., Tucson, AZ 85706 • Tel: (520) 746-1111 • Fax: 910-952-1111
Internet: <http://www.burr-brown.com> • FAXline: (800) 548-6133 (US/Canada Only) • Cable: BBRCORP • Telex: 868-6491 • FAX: (520) 869-1510 • Immediate Product Info: (800) 548-6132

REVISIONS	
ITEM	DESCRIPTION
L7A	ECN PHILLIPS SCREW AND SCREW SCREW - M ADJUST ONE TO SPEC. WHICH P/N F-11100-01 J DASH F-11100-02 J DASH F-11100-03 J DASH
A	ECN PHILLIPS SCREW AND SCREW SCREW - M ADJUST ONE TO SPEC. WHICH P/N F-11100-01 J DASH F-11100-02 J DASH F-11100-03 J DASH
B	ECN PHILLIPS SCREW AND SCREW SCREW - M ADJUST ONE TO SPEC. WHICH P/N F-11100-01 J DASH F-11100-02 J DASH F-11100-03 J DASH
C	ECN PHILLIPS SCREW AND SCREW SCREW - M ADJUST ONE TO SPEC. WHICH P/N F-11100-01 J DASH F-11100-02 J DASH F-11100-03 J DASH

PARTS LIST			
ITEM	DESCRIPTION	QTY	VOLVO &... SEE DASH SCH.
1	MOTOR ASSY. C-21304-00	1 EA	
2	ELECT. ACT. BD. ASSY. C-21312-01 rev. A	1 EA	I-21312-01
3	COVER ASSY. C-21710-01	1 EA	I-21710-01
4	REMOTE INTERFACE CABLE ASSY B-21301	1 EA	I-21301
5	SPACER 1" LONG B-32 CLEARANCE	2 EA	HPSR-0527
6	SOCKET HEAD SCREW B-38 X 1 1/4"	2 EA	HWSG-SCB-208
7	SCREW PHILLIPS HD. 4-40 X 1/4"	4 EA	HPSG-PL4-4
8	BRACKET C-21306	1 EA	I-21306
9	B-32 x 3/8" SOCKET HEAD CAP SCREW	4 EA	HWSG-SCB-69
10	TAG REAR COVER A-21048	1 EA	I-21048
11	CONTROLLER ASSY 2 POS	1 EA	I-21360
12	CONN 6 POS SOC PANDUIT (NOT SHOWN)	1 EA	I-110024-8
13	CABLE ASSY. REMOTE 2' 909 1 FT	1 EA	I-21791-01
14	CORN 6 PIN WIRE WOLEN	1 EA	I-103041042
15	STRAIN RELIEF SRR-10	1 EA	HPSR-10
16	STRAIN RELIEF SRR-4-4	1 EA	HPSR-4-4
17	TAG, CSA CERTIFICATION	1 EA	I-22627
REF	SCHEMATIC B-31313	---	
REF	VIEW WITH DIMENSIONS C-21304	---	
REF	VALVE INSTALLATION (OL MOUNT) B-21446	---	

NOTE: AFFIX TAG TO REAR OF COVER
AFTER S/N, MODEL, AND VOLTS
ARE RECORDED



REMOTE INTERFACE CONNECTIONS

- 5 BLACK - LOAD
- 4 RED - INJECT
- 3 GREEN - COMMON
- 1 WHITE - CONTACT
- 2 SHIELD - GND

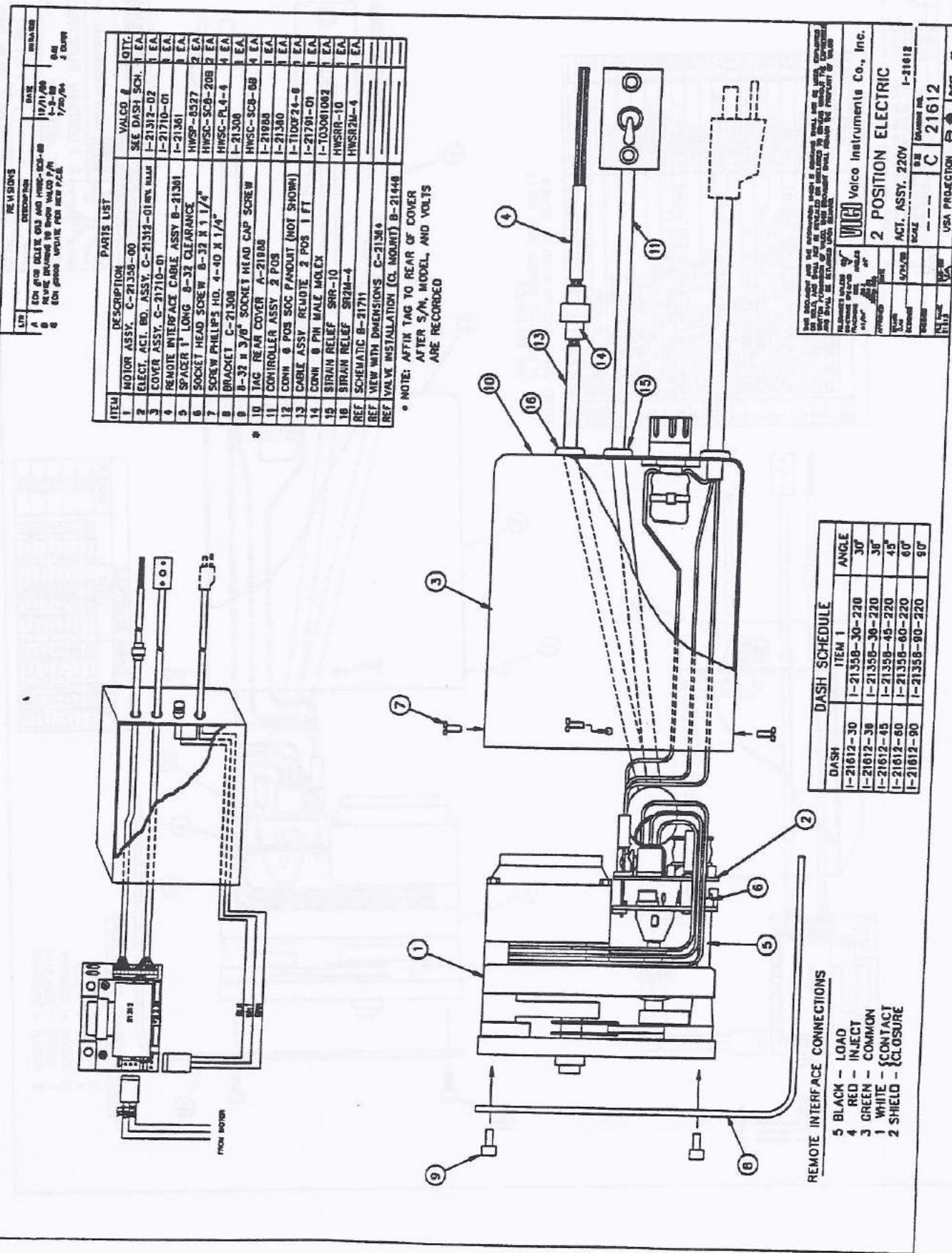
DASH SCHEDULE

DASH	ITEM 1	ANGLE
I-21307-30	I-21358-30-110	30°
I-21307-36	I-21358-36-110	36°
I-21307-45	I-21358-45-110	45°
I-21307-60	I-21358-60-110	60°
I-21307-90	I-21358-90-110	90°

Volvo Instruments Co., Inc.

2 POSITION ELECTRIC
ACT. ASSY. 110V
SERIAL SCALE
NUMBER ---
DATE 1-21-2007
PLATE NO. ---
USA PROTECTION

Volvo Instruments Co., Inc.
2 POSITION ELECTRIC
ACT. ASSY. 110V
SERIAL SCALE
NUMBER ---
DATE 1-21-2007
PLATE NO. ---
USA PROTECTION



REVISIONS	
LIN#	Description Item
N	REMARKS FOR REV. N AND LATER REVIEWS CONNECTORS ON CARTRIDGE BOARD CER. #1543 LAY 20 Below in Eq.
P	10-20-71 11-16-82 J. DUNN

PARTS LIST	
DES	DESCRIPTION
REF	SCHEMATIC LEAD(W) 213136
PCB	PCB ELEC. ACT. 2 POS REV. P (CSA)
C1	CAPACITOR .22uf SOV CERAM.
C2.4	CAPACITOR .47uf 35V TANL.
C3	CAPACITOR 20uf 250V POLY
C5	CAPACITOR 220uf 35V ELEC. RADIAL
C6	CAPACITOR .01uf 1KV CERAM DISK
C7	CAPACITOR .002uf 1KV CERAM. DISK
C01	CONNECTOR 11 PIN PLANOUT MLL5100-11
C02	CONNECTOR 3 PIN MOLEX (PC ST) 25-51-0031
C03	CONNECTOR MOLEX 3 PIN PCB
C04.3	CONNECTOR 3 PIN MOLEX W/ RAMP 0985109.31
D1.2.3	DIODE SIGNAL SILICON 1N914
D1.4	DIODE RECTIFIER SILICON 1N1005
S1	TRIAC 4 AMP 400V
R1	RESISTOR 2.2 MEG 5% 1/4 WATT
R2.3	RESISTOR 330 OHM 5% 1/4 WATT
R4	RESISTOR 27 OHM 5% 1/4 WATT
R5	RESISTOR 36 OHM 5% 1/4 WATT
S1	SIP RESISTOR NET 750-61-330
S2	SIP RESISTOR NET 750-63-47K
S3	SIP RESISTOR NET 750-63-102
SCH-4	SCREW, PLMS: 4-40X1/4 LG
S11.2	STANDOFF THREADED 4-40 H .5
	HWSO-2372 2

PART # FOR 110V. UNITS - I-21312-01
 PART # FOR 220V. UNITS - I-21312-02
 (SEE NOTE 3)

NOTE:

1. CAPACITOR C3 LEADS TO BE SOLDERED INTO THE LOCATIONS MARKED "C3".
2. SCREWS SC3, SC4 TO BE INSTALLED AFTER BOARDS ARE REMOVED FROM CARRIER.
3. FOR 220 VOLT AC UNITS CHANGE -
 - T1 to 1-X-SSC3-24-220
 - C3 to 1-CM03-400

PARTS LIST CONTINUED

REF	DESCRIPTION	PART NUM.	QTY
S01	DIP SOCKET 14 PIN LOW PROFILE	I-TDS-14-LP	1
S02	DIP SOCKET 16 PIN LOW PROFILE	I-TDS-16-LP	1
S03	DIP SOCKET 6 PIN LOW PROFILE	I-TDS-6-LP	1
SW1	DIP SWITCH GATE/HILL 6 PIN DPDT	I-SW-76SDG1	1
T1	TRANSFORMER PARABINE SSC3-24 120 120VAC	I-SSC3-24-120	1
Z1	IC CA3040 SCHOTTKY NANO GATE	I-CA3040	1
Z2	IC CA3040 HEMI BUFFER / DRIVER	I-CA3050	1
Z3	IC OPTO TRIAC WITH ZERO CROSSING MOC3082	I-C3082	1
Z4.5	OPTO DETECTOR REFLECTIVE TYPE TA139 OR EQ	I-CA1139	2
Z6	THREE TERM VOLTAGE REGULATOR 5 VOLT 7805	I-7805	1
RL.W	RELAY, HAMIN	I-NY-HAMIN	1

NOTE:

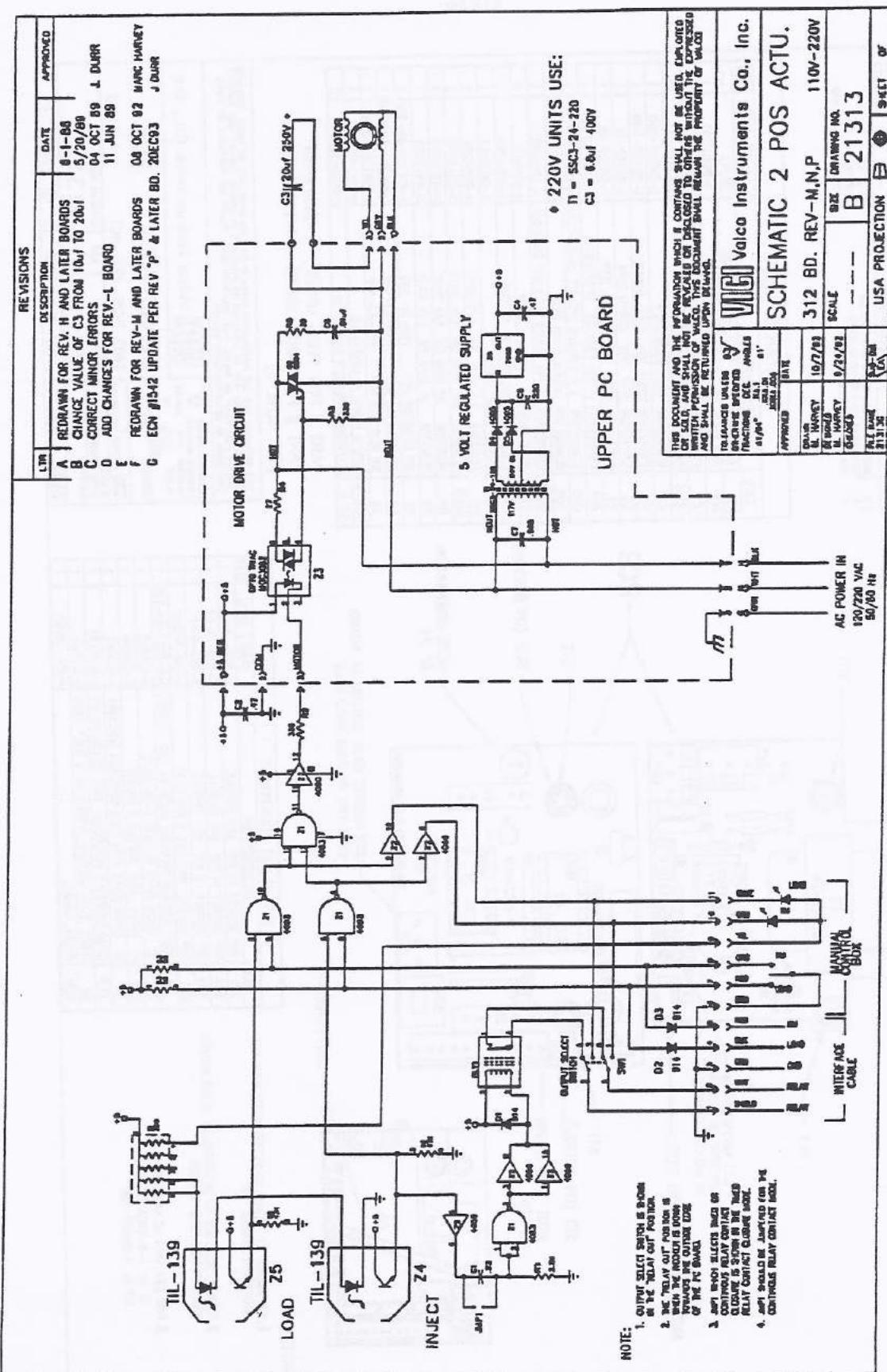
1. CAPACITOR C3 MOUNTED ON BOTTOM OF BOARD IN INDICATED HOLES
2. SCREWS SC3, SC4 TO BE INSTALLED AFTER BOARDS ARE REMOVED FROM CARRIER.
3. FOR 220 VOLT AC UNITS CHANGE -
 - T1 to 1-X-SSC3-24-220
 - C3 to 1-CM03-400

VALCO INSTRUMENTS CO., INC.

TELEGRAPH ADDRESS: VALCO
 TELETYPE NUMBER: 202-467-1000
 CABLE ADDRESS: VALCO
 MAIL ADDRESS: 1000 14th Street, N.W.
 WASHINGTON, D.C. 20004
 PHONE NUMBER: 202-333-1234

PRINTED IN U.S.A.
 DRAWING NO. 21312

REV-P
 BOARD ASSY.
 TWO POS. ELE. ACT
 1-21312





HARRIS
SEMICONDUCTOR

TEL NO:

RJ2011-102

CA555, LM555

Timers for Timing Delays and Oscillator Applications
in Commercial, Industrial and Military Equipment

March 1993

Features

- Accurate Timing from Microseconds through Hours
- Astable and Monostable Operation
- Adjustable Duty Cycle
- Output Capable of Sourcing or Sinking up to 200mA
- Output Capable of Driving TTL Devices
- Normally ON and OFF Outputs
- High Temperature Stability 0.005%/°C
- Directly Interchangeable with SE555, NE555, MC1555, and MC1455

Applications

- Precision Timing
- Sequential Timing
- Time Delay Generation
- Pulse Generation
- Pulse Detector
- Pulse Width and Position Modulation

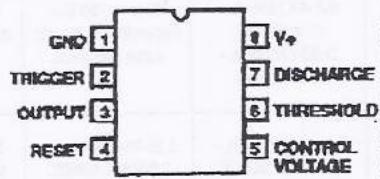
Ordering Information

PART NO.	TEMP. RANGE	PACKAGE
CA0555E	-55°C to +125°C	8 Lead Plastic DIP
CA0555M	-55°C to +125°C	8 Lead SOIC
CA0555M96	-55°C to +125°C	8 Lead SOIC*
CA0555T	-55°C to +125°C	8 Pin TO-5 Metal Can
CA0555CE	0°C to +70°C	8 Lead Plastic DIP
CA0555CM	0°C to +70°C	8 Lead SOIC
CA0555CM96	0°C to +70°C	8 Lead SOIC*
CA0555CT	0°C to +70°C	8 Pin TO-5 Metal Can
LM555N	0°C to +70°C	8 Lead Plastic DIP
LM555CN	0°C to +70°C	8 Lead Plastic DIP

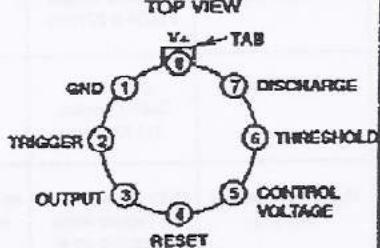
* Denotes Tape and Reel

Pinouts

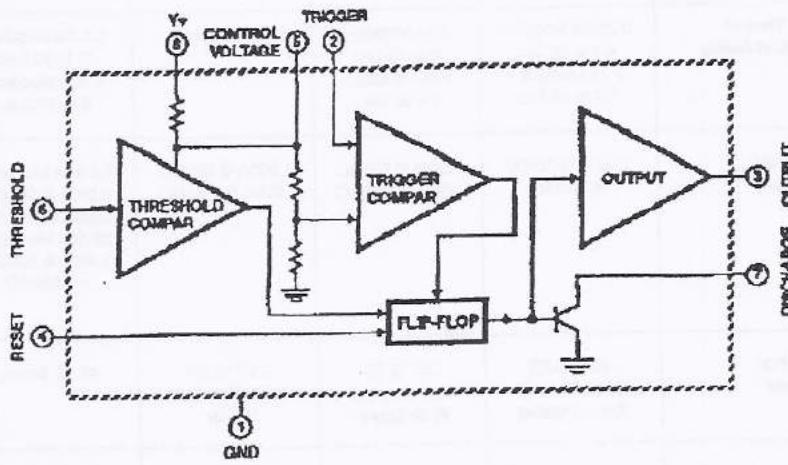
CA555, CA555C, LM555C (PDIP, SOIC)
TOP VIEW



TO-5 Style Package with Formed Leads
CA555, CA555C, LM555C (METAL CAN)
TOP VIEW



Functional Diagram



SPECIAL ANA

File Number 834.2

Circuit Breakers

			NEW			NEW DESIGN	NEW DESIGN
Series	W28	W58	W33	W23	W31	W6	W9
Type	Thermal	Thermal	Thermal	Thermal	Thermal	Magnetic	Magnetic
Features	<ul style="list-style-type: none"> Replaces slow blow glass cartridge fuse and holder Labor-saving snap-in mounting Button extends for visible trip indication Push-to-reset operation 	<ul style="list-style-type: none"> Quick connect or screw terminals Button extends for visible trip indication Push-to-reset operation 	<ul style="list-style-type: none"> Rocker actuator in various colors Convenient, snap-in mounting Optional lighted rockers Models with aux. switch available Designed to meet IEC and VDE requirements. 	<ul style="list-style-type: none"> Push/pull actuation for manual on/off and reset 	<ul style="list-style-type: none"> Toggle actuation for manual on/off and reset 	<ul style="list-style-type: none"> Compact design Variety of time delay options Toggle actuation for manual on/off and reset Optional aux. switch 	<ul style="list-style-type: none"> Variety of time delay options Toggle actuation for manual on/off and reset Optional aux. switch
Approximate Size and Weight (per pole)	a .54" x b .63" x c 1.54" d (.13.7 x 15.9 x 39.0d) 35 oz. (10g)	a .66" x b 1.38" x c 1.38" d (.16.8 x 34.9 x 34.9d) 1.5 oz. (43g)	a .98" x b 1.89" x c 1.72" d (.24.9 x 48 x 43.8d) 1.2 oz. (35g)	a .69" x b 1.38" x c 1.6" d (.17.5 x 34.9 x 40.6d) 2 oz. (57g)	a .69" x b 1.38" x c 1.6" d (.17.5 x 34.9 x 40.6d) 2 oz. (57g)	a .75" x b 2.0" x c 1.64" d (.19.1 x 50.8 x 42.1d) 2.5 oz. (71g)	a .75" x b 2.5" x c 2.1" d (.19.1 x 63.5 x 53.0d) 2.5 oz. (71g)
No. of Poles	1	1	1 or 2	1	1	1 through 4	1 through 4
Circuit Function	Series Trip	Series Trip	Series Trip, both poles or Series Trip, one pole: Switch only, one pole	Series Trip	Series Trip	Series Trip w/ or w/o Aux. Switch, Shunt Trip, Relay Trip, Dual Coil Series Trip, Dual Coil Shunt Trip	Series Trip w/ or w/o Aux. Switch, Shunt Trip, Relay Trip, Dual Coil Series Trip, Dual Coil Shunt Trip
Current Rating	0.25-20 Amps	1-35 Amps	5-20 Amps	0.5-50 Amps	0.5-50 Amps	0.25-50 Amps	0.25-50 Amps
Max. Operating Voltage	32VDC 250VAC	50VDC 250VAC	50VDC 250VAC	50VDC 250VAC	50VDC 250VAC	65VDC 277VAC 480VAC 3e-Wye	65VDC 277VAC 480VAC 3e-Wye
Trip Time at 200% of Rating	0.25-2A Models – 4.5 to 28 Sec. 3-15A Models – 2.2 to 15 Sec.	1-4A Models – 10 to 45 Sec. 5-35A Models – 6 to 30 Sec.	10 to 30 Sec.	0.5-4A Models – 11 to 30 Sec. 5-35A Models – 6 to 22 Sec.	0.5-4A Models – 11 to 30 Sec. 5-35A Models – 6 to 22 Sec.	30ms to 150 Sec. depending upon trip curve specified.	30ms to 150 Sec. depending upon trip curve specified.
Interrupt Capacity	1,000A @ 32VDC or 250VAC	2,000A @ 50VDC 1,000A @ 250VAC	1,000A @ 50VDC 2,000A @ 250VAC	0.5-25A Models – 2,000A @ 50VDC 1,000A @ 250VAC 30-50A Models – 1,000A @ 50VDC or 250VAC	0.5-25A Models – 2,000A @ 50VDC 1,000A @ 250VAC 30-50A Models – 1,000A @ 50VDC or 250VAC	0.25-20A Models – 2,000A @ 65VDC 5,000A @ 277VAC or 480VAC 3e-Wye 21-50A Models – 2,000A @ 65VDC 2,500A @ 277VAC	2,000A @ 65VDC 5,000A @ 277VAC 5,000A @ 480VAC 3e-Wye
Terminal Options	.250" (6.35) Quick Connect (Do not solder)	.250" (6.35) Quick Connect, #6-32 Screw	.250" (6.35) Quick Connect, Solder	#8-32 Screw	#8-32 Screw	.250" (6.35) Quick Connect, #10-32 Screw	#10-32 Stud
Mounting Options	Snaps into 5/8" (15.9) panel cutout from the front	7/16"-28 Threaded Bushing, 15/32"-32 Threaded Bushing	Snaps into .875 x 1.75" (22.2 x 44.5) panel cutout from the front	3/8"-24 Threaded Bushing	15/32"-32 Threaded Bushing	#6-32 Tapped Holes, M3 Tapped Holes, Snaps into panel cutout from the front	#6-32 Tapped Holes, M3 Tapped Holes
Page Number	22	24	27	29	29	32	32

Specifications and/or agency recognitions do not necessarily apply to all models within a particular series.
When multiple ratings are listed, no individual rating may be exceeded by the combination of others.



National
Semiconductor

LM138A/LM138, LM338A/LM338 5-Amp Adjustable Regulators

General Description

The LM138 series of adjustable 3-terminal positive voltage regulators is capable of supplying in excess of 5A over a 1.2V to 32V output range. They are exceptionally easy to use and require only 2 resistors to set the output voltage. Careful circuit design has resulted in outstanding load and line regulation—comparable to many commercial power supplies. The LM138 family is supplied in a standard 3-lead transistor package.

A unique feature of the LM138 family is time-dependent current limiting. The current limit circuitry allows peak currents of up to 12A to be drawn from the regulator for short periods of time. This allows the LM138 to be used with heavy transient loads and speeds start-up under full-load conditions. Under sustained loading conditions, the current limit decreases to a safe value protecting the regulator. Also included on the chip are thermal overload protection and safe area protection for the power transistor. Overload protection remains functional even if the adjustment pin is accidentally disconnected.

Normally, no capacitors are needed unless the device is situated more than 6 inches from the input filter capacitors in which case an input bypass is needed. An output capacitor can be added to improve transient response, while bypassing the adjustment pin will increase the regulator's ripple rejection.

Besides replacing fixed regulators or discrete designs, the LM138 is useful in a wide variety of other applications. Since the regulator is "floating" and sees only the input-to-output differential voltage, supplies of several hundred volts can be

regulated as long as the maximum input to output differential is not exceeded, i.e., do not short-circuit output to ground. The part numbers in the LM138 series which have a K suffix are packaged in a standard Steel TO-3 package, while those with a T suffix are packaged in a TO-220 plastic package. The LM138A/LM138 are rated for $-55^{\circ}\text{C} \leq T_J \leq +150^{\circ}\text{C}$, while the LM338A is rated for $-40^{\circ}\text{C} \leq T_J \leq +125^{\circ}\text{C}$, and the LM338 is rated for $0^{\circ}\text{C} \leq T_J \leq +125^{\circ}\text{C}$.

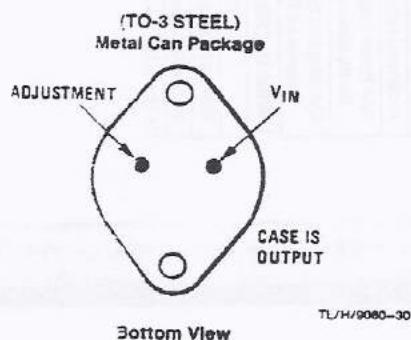
Features

- Guaranteed 7A peak output current
- Guaranteed 5A output current
- Adjustable output down to 1.2V
- Guaranteed thermal regulation
- Current limit constant with temperature
- 100% electrical burn-in in thermal limit
- Output is short-circuit protected
- Guaranteed 1% output voltage tolerance (LM138A, LM338A)
- Guaranteed max. 0.01%/V line regulation (LM138A, LM338A)
- Guaranteed max. 0.3% load regulation (LM138A, LM338A)

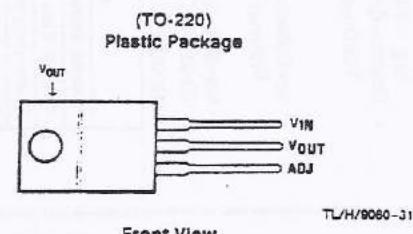
Applications

- Adjustable power supplies
- Constant current regulators
- Battery chargers

Connection Diagrams (See Physical Dimension section for further information)



Order Number LM138AK STEEL/LM138K STEEL/
LM338AK STEEL/LM338K STEEL
See NS Package Number K02A



Order Number LM338AT/LM338T
See NS Package Number T03B

Plastic Medium-Power Complementary Silicon Transistors

...designed for general-purpose amplifier and low-speed switching applications.

- High DC Current Gain —
 $hFE = 2500$ (Typ) @ $I_C = 4.0$ Adc
- Collector-Emitter Sustaining Voltage — @ 30 mAdc
VCEO(sus) = 60 Vdc (Min) — TIP100, TIP105
= 80 Vdc (Min) — TIP101, TIP106
= 100 Vdc (Min) — TIP102, TIP107
- Low Collector-Emitter Saturation Voltage —
VCE(sat) = 2.0 Vdc (Max) @ $I_C = 3.0$ Adc
= 2.5 Vdc (Max) @ $I_C = 8.0$ Adc
- Monolithic Construction with Built-In Base-Emitter Shunt Resistors
- TO-220AB Compact Package

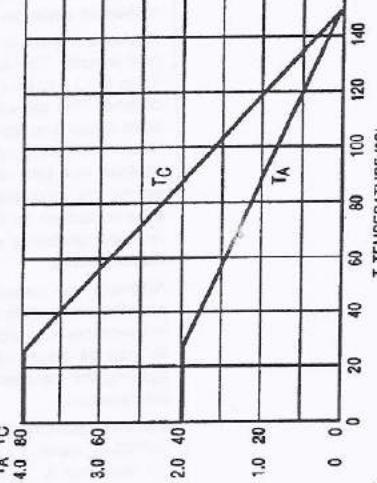
*MAXIMUM RATINGS

Rating	Symbol	TIP100, TIP105	TIP101, TIP106	TIP102, TIP107	Unit
Collector-Emitter Voltage	VCEO	60	80	100	Vdc
Collector-Base Voltage	VCB	60	80	100	Vdc
Emitter-Base Voltage	VEB		5.0		Vdc
Collector Current — Continuous	I_C		8.0		Adc
Peak			15		Adc
Base Current	I_B		1.0		Adc
Total Power Dissipation @ $T_C = 25^\circ C$	P_D		80		Watts W/ $^\circ C$
Derate above $25^\circ C$			0.64		mW
Unclamped Inductive Load Energy (1)	E		30		Watts W/ $^\circ C$
Total Power Dissipation @ $T_A = 25^\circ C$	P_D		2.0		Watts W/ $^\circ C$
Derate above $25^\circ C$			0.016		
Operating and Storage Junction Temperature Range	T_J, T_{SJg}		-65 to +150		$^\circ C$

Thermal Characteristics

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _{θJC}	1.56	$^\circ C/W$
Thermal Resistance, Junction to Ambient	R _{θJA}	62.5	$^\circ C/W$

(1) $I_C = 1.1$ A, $L = 50$ mH, P.R.F. = 10 Hz, $V_{CC} = 20$ V, $R_{BE} = 100 \Omega$



$P_{D,1} = \text{Base}$
 $2 = \text{Col}$
 $3 = \text{Emi}$.

Figure 1. Power Derating

Preferred devices are Motorola recommended choices for future use and best overall value.
REV 7

Glow Discharge Photoionization Detection Lamp (PID) - Model 108

108-10.0/10.6 eV

From the

"Pioneers of PID™"

Scientific Services Co., Inc.

P. O. Box 317, Rocky Hill, NJ 08553

108-10.0/10.6

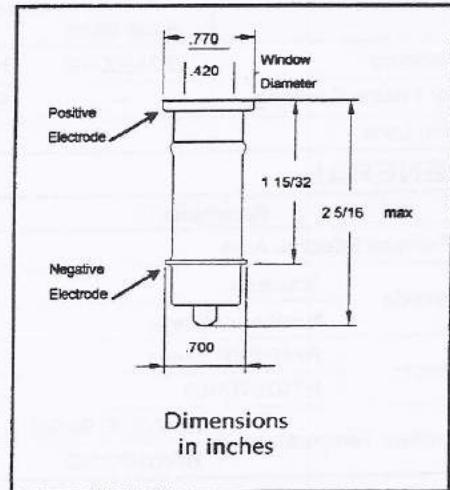
The most popular of our line of PID lamps is the Model 108-10.0/10.6. This model is used in all PID detectors employing glow discharge lamps with the exception of the HNU type*. This Model 108 utilizes a small and efficient envelope (see Dimensional Drawing below). The VUV energy is emitted in spectral lines at 10.0 eV to 10.6 eV.

(*For HNU style instruments, see our original PID lamp Model 103)

Photograph of Model 108



Dimensional Drawing



Order by calling 609-921-3358 or fax
Purchase Order to 609-921-2549

For more product information, see our
web site at www.sciserv.com or email us
at info@sciserv.com

"Pioneers of PID" is a trademark of Scientific Services Co., Inc.

Product Warranty

Only Scientific Services offers a three month warranty, provided normal operation does not exceed 1 ma at 250° C. This applies whether purchased direct from us or from one of our distributors. (Excludes Model 109-11.8)

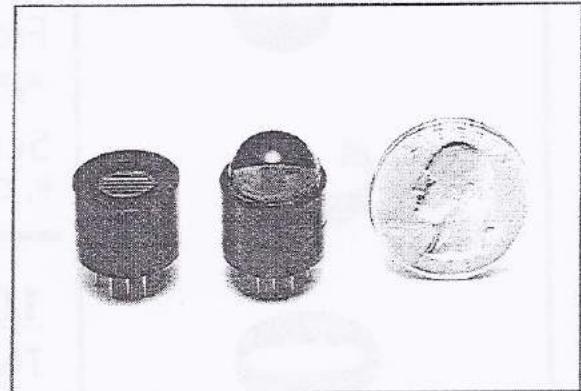
April 1998

HAMAMATSU

**METAL PACKAGE
PHOTOMULTIPLIER TUBE
R7400U SERIES**

**Compact size (16mm diameter, 12mm seated length),
Fast Time response (rise time 0.78ns)**

The R7400U series is a subminiature photomultiplier tube with a 16mm diameter and 12mm seated length. A precision engineered 8-stage electron multiplier (composed of metal channel dynodes) is incorporated in the TO-8 package to produce a noise free gain of 700,000 times (R7400U). Its improved metal channel dynode design increases photoelectron collections efficiency by 30% than the previous type. The R7400U series also features excellent response time with a rise time of 0.78ns. Various types of the R7400U series are available with different spectral response and gain ranges, including those selected specifically for photon counting applications. Hamamatsu also provides a hemispherical lens input option to the series (R7401 and R7402), effectively doubling the active area.



Left: R7400U Right: R7401/R7402

FEATURES

- World's smallest photomultiplier tubes assembled in a TO-8 metal package (1/7th of the Hamamatsu R647). The necessary components are built into a TO-8 package while retaining full photomultiplier tube performance to create a new generation of photosensors.
- Increased photoelectron collection efficiency. The improved metal-channel dynode delivers photoelectron collection efficiency 30% higher than former types R5600U.
- Photon counting types: R7400P series. The R7400P series is specially selected on account of low noise and high gain for use in photon counting applications.
- Hemispherical lens window types: R7401 (bialkali), R7402 (multialkali). The hemispherical lens window doubles the effective input area to 12mm in diameter.

SERIES

	Solar Blind	UV to Visible Range	UV to Near IR Range	Insulation Cover
Standard	R7400U-09	R7400U/R7400U-03/R7400U-06	R7400U-01/R7400U-02/R7400U-04	Yes
For Photon Counting	—	R7400P/R7400P-03/R7400P-06	R7400P-01/R7400P-04	Yes
With Lens	—	R7401 (Visible Range)	R7402 (Visible to Near IR Range)	Yes

GENERAL

Parameter		Description/Value	Unit
Minimum Effective Area		8	mm ϕ
Dynode	Structure	Metal Channel	—
	Number of Stage	8	
Weight	R7400U/P Series	Approx. 5.3	g
	R7401/R7402	Approx. 6.3	
Ambient Temperature	R7400U/P Series	-80 to +50	°C
	R7401/R7402	-30 to +50	

VOLTAGE DISTRIBUTION RATIO

Electrodes	K	Dy1	Dy2	Dy3	Dy4	Dy5	Dy6	Dy7	Dy8	P
Ratio	1	1	1	1	1	1	1	1	0.5	

Supply Voltage: 800V K: Cathode Dy: Dynode P: Anode

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