Robot Builder

The Official Publication of the ROBOTICS SOCIETY OF SOUTHERN CALIFORNIA
Post Office Box 26044, Santa Ana, CA 92799-6044

PRESIDENTS MESSAGE

by Jess Jackson

Hot weather is here but is not unusual for the month of July. Did everyone see the Mars landing? Hope for good weather on Mars.

Don Golding and Bob Gross, two of our members were asked by the Discovery Channel, World of Wonder program to interview them and to shoot footage of operating robots. Bob generated this shoot from his involvement with Robot Wars. The shoot was done Friday, July 25. Don provided almost all of the robots. He took a WHISKERS, an ADVANCED WHISKERS, GOLDIE II (the military robot), the MR1, PIPE BOT I, and PIPE BOT II. The program may air in August on Friday some time in that month. I'll keep you informed if I can get the final date for the showing.

The tentative schedule for the July 12 meeting will be as follows:

12:30 RSSC business meeting (short one)

1:00 General meeting (needs to start immediately)

Topics

Small Robot developments, pipe inspection robot II, Grippers - Jess Jackson

"Practical Robotics" New Book review - Tom Thornton

Open forum discussion of problems and membership projects - Membership

3:30 adjourn

ITEMS OF MAJOR INTEREST:

Remember the 68HC11 SIG (Special Interest Group) now meets at 9:00 before the Main meeting in the Robot Lab (room 301) in the CS building just east of engineering building.

ITEMS OF INTEREST two:

We have a need to measure current in our robots. It may be wheel current, or motor current on an arm to determine the lifted weight, or even monitor the total draw from the battery to determine remaining charge. The F.W.BELL (Division of BELL TECHNOLOGIES, INC) has announced a new current sensor device. In the past, the measurement of the voltage drop across a resistor or a HALL EFFECT device measuring the flux in a coil of wire or a ferrite core were the methods available to measure current.

BELL has developed a postage stamp size device. When size and accuracy are critical, their NT series current sensors may be the devices to use. The NT series operate from 5 to 50 amperes. They use a buss-bar conductor instead of a core. This allows BELL to decreases the over all package thickness. The current passes through the buss-bar and is sensed by the sensor's geometric network which measures the absolute magnetic field strengths and field gradients.

(continued on page 5)

In This Issue

Faire Committee Meeting

Date: July 12
Time: 11:30 a.m.
Place: CSUF EE 321

68HC11 SIG

Date: July 12
Time: 9:00 a.m.
Place: CSUF CS 301

BRINGING NICDS BACK FROM THE DEAD

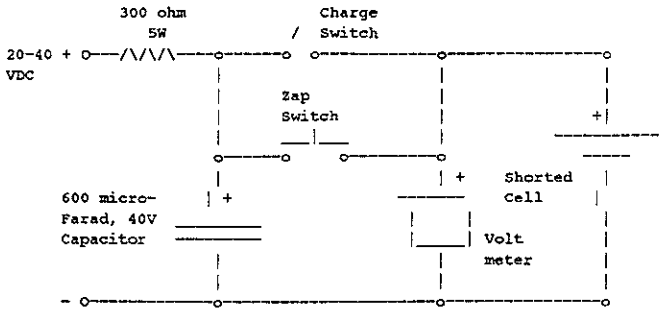
TRB Staff

One common battery failure occurs in multi-cell Ni-Cd battery packs and is due to the voltage difference between cells. Say you have four 1.25 V cells in a pack connected to a 200 ohm load. The load "sees" 5 volts and draws 25 mA. Since each cell must pass the entire 25 mA and each cell's potential is 1.25 volts, Ohm's Law tells us that each cell sees the equivalent load of 50 ohms.

But in practice, no four cells in a battery ever exhibit exactly the same output voltage. Assume that one cell is delivering only 1.2 V, and the others are at 1.25 volts. Now, the 200 ohm load sees 4.95 volts and draws 24.75 mA. Since all four cells must pass the entire 24.75 mA, each of the strong cells at 1.25 volts sees an equivalent load of 50.5 ohms; the weak cell sees only 48.5 ohms. The weak cell works into the heaviest load and as a result will discharge more rapidly than the other cells. If the pack is charged for only a short period of time, the weak cell, which has been working the hardest, is also the one that receives the least charging power.

This usually doesn't matter if you trickle charge after each day of flying. The inequality is small for any given charge or discharge cycle, due to the relatively flat output voltage NiCd cells exhibit over most of their range. But a combination of incomplete charges and deep discharges will exaggerate the energy difference between a weak cell and the other cells. Operated continually in this manner, the weak cell invariably reaches its "knee", the point at which its voltage decreases sharply, long before the other cells reach the same point.

Now comes the problem! Suddenly, the weakest cell sees an increasingly heavy load, which causes its voltage to drop even faster. This avalanche continues until the cell is completely discharged, even as the other cells continue to force current to flow. The inevitable result is that the weak cell begins to charge in reverse, which eventually causes an internal short. Once an internal short develops, recharging the cell at the normal rate is futile. The short simply bypasses current around the cells active materials. (Even though the cell is apparently dead, most of its plate material is still intact.) If the small amount of material that forms the short could be removed, the cell would be restored to virtually its original capacity once again.



Using the circuit shown, the internal short can be burned away in a few seconds. In operation, energy stored in the capacitor is rapidly discharged through the dead cell to produce the high current necessary to clear the short. Current is then limited by the resistor to a safe charge rate for a small A cell.

Several applications of discharge current are usually necessary to clear a cell. During the "zapping" process, it is a good idea to connect a voltmeter across the cell to monitor results. Momentarily close the normally open pushbutton switch several times to successively zap the cell, allowing sufficient time for the capacitor to charge up between zaps, until the voltage begins to rise. Then, with the toggle switch closed, watch as the potential across the cell climbs to 1.25 volts. If the potential stops before full voltage is reached, some residual short remains and another series of zaps is in order. If you observe no effect whatsoever after several zaps and shorting out the cell and taking an ohmmeter measurement indicates a dead short, the cell is beyond redemption and should be replaced.

Once full cell potential is achieved, remove the charging current and monitor battery voltage. If the cell retains its charge, it can be returned to charge and eventually returned to service. But if the cell slowly discharges with no appreciable load, the residual slight short should be cleared. To do this, short circuit the cell for a few minutes to discharge it, zap again, and recharge it to full capacity.

ROBOTIC MICROSURGERY MAKES DIFFICULT PROCEDURES EASIER

Gary Chamberlain – Design News June 9, 1997

A new robotic assisted surgical system will enable doctors to perform delicate operations to the eye, ear, spine, heart, and brain with greater dexterity. NASA and Dr. Steve Charles of MicroDexterity Systems, Memphis, TN, co-developed Robotic-Assisted MicroSurgery (RAMS). Charles originated the concept of a telerobotic system to assist the microsurgeon, and engineers at the Jet Propulsion Laboratory developed RAMS based on surgical requirements provided by Charles. The primary control mode of RAMS is teleoperation where the operator's hand motions are transferred by a sophisticated joystick like, hand controlled device. It includes features that enhance a surgeon's manual positioning and tracking, helping the surgeon to overcome involuntary jerks and tremors. The first element of the RAMS workstation, now under test, is a six degree of freedom surgical robot made up of a torso-shoulder-elbow body with three-axis wrist. Clinical testing of the system will begin this year.

AUTONOMOUS LEGGED UNDERWATER VEHICLES

TRB Staff - Cyber News April 1996

Autonomous legged underwater vehicles are being jointly developed by Rockwell, IS Robotics and UC Berkeley for mine hunting and neutralization in very shallow water and in the Surf Zone. Their mission is to covertly search a region of shallow water before an invasion, and to find and neutralize mines and other obstacles. The Problem: covertly locate and neutralize mines in the Surf Zone. The Solution: small inexpensive autonomous legged robots. Why legs? Legged animals navigate easily in the surf. Legs are an excellent sensor platform. Why autonomous? Mission does not depend on any one component. Robust performance despite loss of vehicles. Each vehicle operates autonomously. No central control or planning. Minimal communication. The overall result: collectively, the ALUVs perform an efficient large scale search. The Design: 6 legs, 2 degrees of freedom per leg, waterproof body, obstacle detecting feelers, sensor-based search, touch-based mine sensors, autonomous operation, behavior-based control, obstacle avoidance behaviors, multi-sensor detection & characterization, posture adjustment to resist wave forces, explode on command. The Results: systematic search, mine detection, detailed inspection of the mine using leg-mounted sensors. The ALUV then buries itself in the sand near the mine to await detonation. This project is funded by the Advanced Research Projects Association.

Solid State Circuit Breaker

Craig B. Ziemer

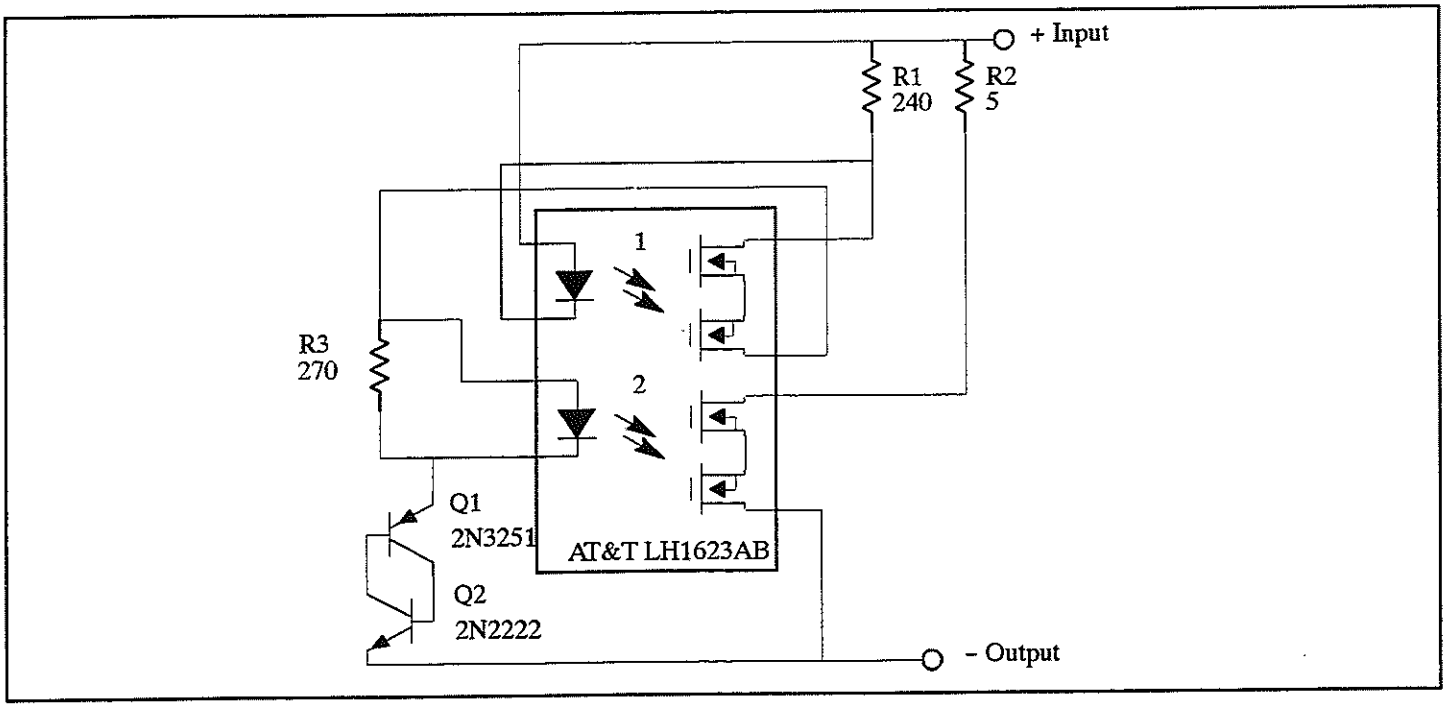
An optically coupled solid state relay (SSR) can be used to form a programmable dc circuit breaker. In addition to its breaking capacity, the circuit obviously has the accompanying advantages of solid state: fast response, small size, and high reliability.

Looking at the details of the setup, the AT&T LH1523AB is a dual form-B (normally closed contacts) SSR with 10 ohm (typical) contacts that can handle 0.2A when operated independently. Channel 1 of the SSR and R1 form a 5 mA current source to provide LED current to the breaker switch on Channel 2.

As the output current increases, the voltage across the circuit breaker increases proportionately. When this voltage reaches about 3V, sufficient voltage is available to trip the SCR, which is formed by Q1 and Q2, into its low resistance state. This allows Channel 2 LED current to flow, which rapidly turns off the SSR.

After the breaker trips, a small quiescent current of 5 mA continues to flow to maintain the SSR in the off state. R2 adjusts the trip current value, which is simply 3 V/(10 ohm + R2). The circuit breaker remains latched in the off state until the voltage across it approaches 3 V, at which point the SCR turns back off and the SSR turns on. This, in effect, resets the circuit breaker.

The circuit arrangement shown will trip at a current of 0.2A. The voltage across the circuit breaker must be limited to less than 120V to maintain the SSR power dissipation below the absolute maximum rating of 0.6W. The SSRs also can be configured easily in series or in parallel for increased voltage or current ratings.



RSSC History – Five Years Ago

Tom Thornton

Robot Builder Editor Scott MacGillivray announces his departure. He'll be sorely missed. Scott has plans for moving out of the area. We wish him well where ever he lands.

President Jerry Burton announces the eminent arrival of the First Annual Robot Faire. Yes, August 2 is just around the corner and it's Faire Time.

Contest Rules – a) MicroMouse b) Push Off – a SumoBot variant, c) Slalom d)Take the Money – a voice controlled bot (very tough) e) Robot Laser Wars f) Design and Demo Projects.

JPL developed a high-clearance six-wheel suspension. The inter-wheel linkages are above the wheels instead of at axle level.

Deep Cycle Battery Frequently Asked Questions – Part IV

Bill Darden

(Editor's Note: This is the last of a four part series on deep discharge lead acid batteries. Parts I, II, and III appeared in the April, May, and June 1997 issues of ***The Robot Builder.***)

The following, and the related Car Battery FAQ are the work of Bill Darden, who welcomes your comments. All of the usual disclaimers apply.

A word of caution. Batteries contain a sulfuric acid electrolyte which is a highly corrosive poison, that will produce gasses when recharged and explode if ignited. This will hurt you--BAD! When working with batteries, you need to have plenty of ventilation, remove jewelry, wear protective clothing and eye wear (safety glasses), and exercise caution. Whenever possible, please follow the manufacturer's instructions for testing, jumping, installing and charging. This FAQ assumes a six cell battery commonly used for 12 volt negatively grounded system in most recreational applications. For six volt batteries, divide the voltage by two.

The technical stuff is in [brackets].

8. WHAT ARE THE MOST COMMON CAUSES OF BATTERY FAILURES?

A. Loss of electrolyte due to heat or overcharging,

B. Sulfation in storage,

C. Undercharging with voltages less than 13.8 volts,

D. Old age,

E. Vibration,

F. Freezing,

G. Using tap water,

H. Corrosion.

9. WHAT ARE SOME OF THE MYTHS ABOUT BATTERIES?

A. Storing a battery on a concrete floor will discharge them.

Modern lead acid battery cases are better sealed, so external leakage causing discharge is no longer a problem. [Temperature stratification within large batteries can accelerate the internal "leakage" or self discharge if the battery is sitting on an extremely cold floor in a warm room or installed in a submarine.]

B. Driving a vehicle will fully recharge a battery.

There are a number of factors affecting alternator's ability to charge a battery. The greatest factors are how much current from the alternator is diverted to the battery to charge it, how long the current is available and temperature. Generally, running the engine at idle, short "stop-and-go trips", or during bad weather at night will not recharge the battery.

C. A battery will not explode.

While recharging, a battery produces hydrogen and oxygen gasses. If a spark occurs, an explosion can occur. Remember the "Hindenburg"?

D. A battery will not lose its charge sitting in storage.

A battery has internal electrical leakage that will cause it to become fully discharged and sulfated over time. Prior to storing a battery, it should be fully charged and recharged when it reaches 80% state-of-charge or six months, whichever occurs first.

E. How long will a deep cycle battery last?

Discharging, like charging, depends on a number of factors. The most important ones are the initial state-of-charge, capacity of the battery, load and temperature. For a fully charged battery at 80

degrees F, the ampere hour rating divided by the load in amps will provide the estimated life of that cycle. For example, a 72 ampere hour battery with a 10 amp load should last approximately 7.2 hours.

10. WHERE CAN I FIND MORE INFO ON BATTERIES?

AC Delco Counterman Training Program,

AC Delco Home Page,

"Auto Batteries", Consumer Reports, October, 1991.

"Automotive Battery FAQ", Exide Batteries,

"Automotive Electrical Troubleshooting Manual", Interstate Batteries, Dallas.

"Batteries", Consumer Reports, February, 1987.

"Battery Replacement Data Book", Battery Council International, Chicago, 1996.

"Battery Service Manual", Battery Council International, Chicago.

"Battery Training Guide", Exide, Reading, PA.

"Best Bet in Auto Batteries", Consumer Reports, October, 1995.

Darden, William E., "Car Battery FAQ", .

Darden, William E., "Deep Cycle Battery FAQ",

DC Battery Specialists Home Page,

Electrochemical Science and Technology Information Resource Home Page,

Exide Battery Home Page,

"First Aid for an Auto Battery", Consumer Reports, November, 1995.

Hawkins, Tim, "Batteries: Playing Pinball with Atoms", Nuts & Volts Magazine, November, 1995.

Interstate Batteries Home Page,

Japlar/Schauer Battery Charger Home Page,

Johnson Controls Inc. Home Page,

Lead Acid Batteries Home Page,

Scheidler, Ralph E., "Introduction to Batteries and Charging Systems", Sure Power Systems, Tualatin, OR.

Sci.chem.electrochm.battery, USEnet Newsgroup.

Ultimate Energy Hope Page,

Comments are always welcomed by Bill Darden at wdarden@mcimail.com or (214) 361-9566. For additional information on car batteries, the Car Battery FAQ maybe found on the Web server at

www.ee.ualberta.ca/~schmaus/ or by requesting one via email from Bill Darden.

ROBOCUP

TRB Staff

RoboCup is an international attempt to foster AI and intelligent robotics research by providing a standard problem where a wide range of technologies can be integrated and examined. In order for a robot team to actually play a soccer game, various technologies must be incorporated: design principles of autonomous agents, multi-agent collaboration, strategy acquisition, realtime reasoning, robotics and SENSOR-FUSION. Unlike the AAAI robot competition, which is tuned for a single heavy-duty slow-moving robot, RoboCup is a task for a team of multiple fast-moving robots under a dynamic environment. Although the final target is a world cup with real robots, this project initially offers a platform for software research. A prototype version of the RoboCup Software Simulator is already available. The official sim will be announced at the end of this year. The first RoboCup will kick off during IJCAI-97 (International Joint Conference on Artificial Intelligence) to be held at Nagoya in Japan from August 23-29, 1997.

Presidents Message (continued from page 1)

ITEMS OF INTEREST three:

I finished a design of a second pipe inspection robot. It was a follow on to the robot I displayed at the last meeting. It was again a four wheel machine, but slightly shorter in length. The lower ends of the frame are tapered under so the bot can traverse tighter pipe bends. The biggest change is the rotate and tilt head for the color camera and lighting. The mechanism for the rotate function is located in the body. This includes a full servo function with a drive motor and positional feedback. It will rotate the camera a full 360 degrees.

The color camera is located in an ABS plastic box for protection. The tilt motor servo control will slew the camera about 200 degrees allowing full forward to full rearward observation.

The video and control information are also transferred via trailing wire to the operator. The laptop computer captures the images on the display via a screen grabber. When the operator

sees something of interest, the current image is stored in memory for future use. I'll have pictures of this one if I can't bring it to the meeting.

ITEMS OF INTEREST four:

About three weeks ago, a four wheel drive robot began to travel across Chile's Atacama Desert. It is a semi-autonomous machine named NOMAD developed by CARNEGIE MELLON UNIVERSITY. This university team, led by "RED" WHITTAKER thinks big. They were the team that developed the 10 ton MARS walker. This time they are thinking a bit smaller. The NOMAD is about a 1000 lbs as presently equipped and moves at about one(1) mile an hour. The rover will remain in the desert for a six(6) week journey.

The Atacama Desert has virtually no vegetation and a landscape similar to that of the moon or MARS. Funded by tax payers money via NASA, the NOMAD project has a goal of traversing 125 miles of desert terrain with the robot under remote control by a team at the CARNEGIE SCIENCE CENTER.

The robot is roughly the size of a compact car. The rovers large aluminum wheels turn independently and extend out from the chassis for added stability on uneven terrain. It has three sets of stereo cameras in front and a 360 degree panospheric camera that enables the remote drivers to see all around the robot.

Visitors to the CARNEGIE SCIENCE CENTER will be able to pilot the NOMAD and we can track its progress over the World Wide Web at http://img.arc.nasa.gov/Nomad/nomad.html and the other address is http://www.ri.cmu.edu/atacama-trek/.

(An article will appear in TRB August issue. ed.)

ITEMS OF INTEREST five:

RED ROVER, RED ROVER is the cry of The Planetary Society. There was some discussion at last meeting of what this program incorporates. Some of us knew a little about it but we all needed more details. So Joan and I went to Pasadena to obtain more details. This also provided a good opportunity to visit the roboteers friendly motor store, C & H Surplus.

The literature starts out "The RED ROVER project is the most compelling classroom learning experience that The Planetary Society has ever conceived". Wow. I don't know how compelling it is but it sure seems expensive.

The first level is called an EARTH SITE. For a cost of $60.00 you get educational material, a one year membership to The Planetary Society and access to MARS Sites and MARS bases.

The second level is called a MARS SITE. A MARS Site has the equipment and software to control rovers at other MARS Sites and MARS Bases, to locally control its own rover and to interact and be controlled by all other sites. For the cost of $1,141.00 the society allows you to build a Mars Site. They send you Control software, a miniature B&W Camera, velcro for mounting, camera power and data cables, and a LEGO DACTA Control Lab Starter Kit plus lots of other educational materials.

The next level is a MARS BASE and involves serious investment. This level is reserved for science centers and planetariums. They say call for pricing. I guess this is to help reduce sticker shock.

The minimum equipment needed at a MARS site or base is a 386 PC running windows, Netscape 2.0 or greater, 4 MB of RAM, 20 MB of free hard disk space, VGA 480x600, 9600 baud modem, mouse, 1 parallel port for camera, and 1 serial port for LEGO DACTA interface. With this setup you can operate your own and LEGO robots at other sites.

I intend to do more investigation into the LEGO motor controller. It probably is a serial shift register that controls three states for each motor. A three bit word could control all the motor states quite well.

Again we all should thank Tom Thornton for the effort that he puts into the Robot Builder every month. How many of you submitted an item of interest for publishing in the ROBOT BUILDER? He and I both say please.

See you at the meeting. . . . . JJ

WIN FAME and FORTUNE ! Be a LEGEND !

OK OK so the fame is somewhat limited, being among the hundred or so folks who read this rag each month . . . Didn't Andy Warhol say something about everybody getting his fifteen minutes of fame? This may be your chance.

And the fortune may only be the warmth in the cockles of your heart knowing you've made a contribution to the hobby you love.

Legend? Well, yes, I did say legend. I suppose you could keep the issue your article appears in and show it to your grandchildren - I know I do.

The point is this - filling eight pages (really only four because Jesse is always good for two and there is filler on pages 7 and 8) every month is not a sneeze.

How about this? If you don't have an article you are willing to submit, just send in an idea or outline for an article you would like to see appear. I'll put the STAFF to work researching your subject and give you by-line credit for the idea.

Robotic Regards
Tom Thornton
TRB Editor

Membership / Renewal Application:

Name _____

Address _____

City _____

Home Phone ( ) - Work Phone ( ) -

Annual Dues: Newsletter & Membership ($20) Check #

Area(s) of Interest / Background

Return To: RSSC
Post Office Box 26044
Santa Ana, CA 92799-6044

How did you hear about RSSC?

The Robotics Society of Southern California was originally formed in 1989 as a non-profit experimental robotics group. The intent was to establish a co-operative association among related industries, educational institutions, professionals and particularly robot enthusiasts. Membership in the society is open to all with an interest in this exciting field.

The primary goals of the society are to promote public awareness of the field of experimental robotics and encourage the development of personal and home based robots.

The RSSC publishes this monthly newsletter, The Robot Builder, that documents various Society activities, robot construction projects, and other information of interest to members.

The Robot Builder is published monthly by the Robotics Society of Southern California.

The yearly membership fee includes a subscription to this newsletter and is available for $20.00.

Membership applications should be directed to:

Robotics Society of Southern California
Post Office Box 26044
Santa Ana, CA 92799-6044

Manuscripts, drawings and other materials submitted for publication that are to be returned must be accompanied by a stamped, self addressed envelope or container.

However, RSSC is not responsible for unsolicited materials.

If possible please submit copy in ASCII via diskette or email:

mandtsys@ix.netcom.com

Tom Thornton - Editor

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