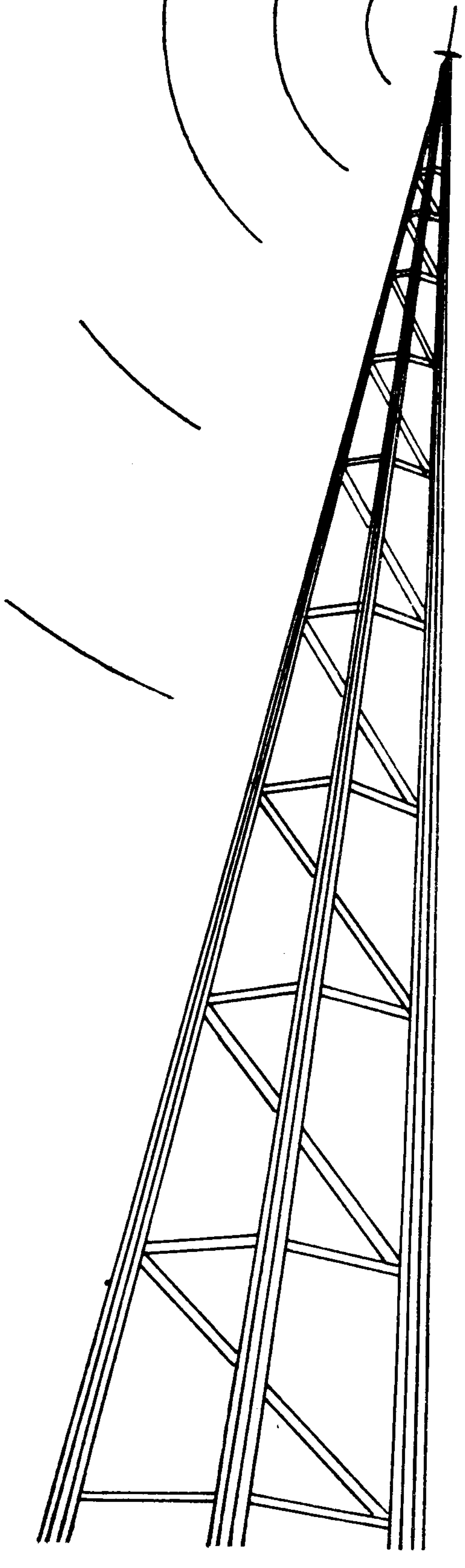
QSX PE



ZS2PE

FREQUENCIES:

Bulletin	3640 Khz
	7098 Khz
National Call	145.5 Mhz
P.E. Repeater	145.05/65
Grahamstown	145.15/75
Lady's Slipper	145.10/70

Port Elizabeth Branch of the South African Radio League

P.O.Box 462, Port Elizabeth. 6000.

12 JUL 1982

›NOTICE OF MONTHLY MEETING‹

MEMBERS ARE REMINDED THAT THE JULY GENERAL MEETING TAKES PLACE ON FRIDAY JULY 16th, AT THE Y.M.C.A., HAVELOCK STREET, PORT ELIZABETH AT 8 PM.

****

The after-business entertainment at the meeting will be a show of films from the FBI in the States on what to do to prevent crime as it befalls the man-in-the-street, like mugging, bag-snatching,etc. Please bring your wives and older children along as the films will be of help to them. The films are not suitable for viewing by very young children, so get your favourite babysitter on the phone, and come along to the meeting.

ITS THAT TIME OF YEAR AGAIN !!! Members are reminded that their subs are due now for the coming year. Unfortunately they have been increased yet again, and stand at R18 for ordinary members, and R8 for all other classes of membership. If you intend remaining a member of the Branch, please make every effort to let us have your cheque as soon as possible, as this makes the task of all involved with processing the subs very much easier. Unless someone at HQ has slipped up, everyone will have received their renewal cards by now.

****

NEWS

SILENT KEY: It is with very deep regret that we have to announce the passing of a very long-standing member of the Branch. OM Ken Bradley ZS2HI passed away a few weeks ago. Ken had been off the air for a long time as a result of illness, but was very well known to all the older hams in the area, and was a very keen CW man, and HF DX'er, particularly on 80 and 40. To Ken's family and friends we extend our sincere condolences.

****

OM John St.Clair ZS2JR is away from home again at the moment, having travelled to Britain for a dental operation. John was to spend about a week overseas and then two weeks in Johannesburg investigating a new position which his saltmine has offered him.Here's hoping the operation was f completely successful John.

OM Ray ZS2RE formerly of East London has just taken up residence in P.E. Ray and his family have their new QTH in Nile Road, and Ray has already set up some antennas. Welcome to the area Ray.

OM Le Fras ZS2TW and his XYL Marie have sent us a donation of R24 towards the AGM fund. Thanks very much to you both for this fine gesture.

Our sincere thanks to all those who assisted with the comms for the air-navigation exercise held recently. The organisers were well pleased with our efforts, and have donated R50 to our AGM fund.

HOBBIES FAIR: The Hobbies Fair takes place this year at the Feather Market Hall as usual from the 12th to the 17th July.Keep a look out for our station which will use the call ZS2PE on HF and VHF.

BIRTHDAYS, Etc: Birthday wishes are extended to OM Ray Bently for the 2nd, XYL Julie Scarr for the 3rd, OM Sel ZS6AXO for the 16th, OM Seymour ZS2RX and Priscilla ZS2-070 for the 22nd, OM Le Fras ZS2TW for the 25th and XYL Lil Franz for the 27th. OM Brian ZS2AB and Marge ZS2OB celebrate their wedding anniversary on the 4th. Heartiest congratulations to you all.

BULLETIN ROSTER.

18th July	Dick ZS2RS, (322111)
25th July	Brian ZS2AB,(303498)
1st August	Marge ZS2OB (303498)
8th August	Frank ZS2CY (511259)
15th August	Colin ZS2AO (312471)

Lets have all your news in time for the bulletin please.

MINUTES OF THE GENERAL MEETING OF THE PORT ELIZABETH BRANCH OF THE SOUTH AFRICAN RADIO LEAGUE, HELD AT THE Y.M.C.A., HAVELOCK STREET, PORT ELIZABETH ON FRIDAY 18th JUNE, 1982.

PRESENT: 21 members and visitors.

APOLOGIES: ZS2RT, ZS2TJ, ZS2KT, ZS2TX, ZR2ED, ZS2S, ZS2CZ.

The Chairman extended a welcome to all and especially to the Uitenhage members and Fred ZS2JS, Viv ZS2VM, Ronnie ZR2AD, Attie ZR2DY and Kevin Adriaanzen.

MINUTES: The Minutes of the meeting held 21st May, having been published and circulated in QSX-PE were tabled. Cyril ZS2KX raised the question of the 1984 A.G.M. having been absent from the previous meeting. The Chairman replied and the minutes were then taken as read, proposed by ZS2EQ and seconded by ZS2CY.

FINANCE: The Treasurer said that the state of the finances was healthy.

CORRES: The following were tabled:
Council Minutes and Financial Statement
Letters from H.Q. and I.A.R.U. re 10 mHz SSB operàtion
Card of thanks from Alan and Naydene.

GENERAL: The Chairman said that his present stock of tape-recorders was sold out, and that over R300 had been realised towards AGM funds. Thanks to all those who had bought them. A separate account for the AGM had been opened. A vote of thanks to the Chairman was proposed by Gus ZS2MC and seconded by Colin ZS2AO and the whole meeting.

Viv ZS2VM said that the members present at the last meeting of the Algoa Branch voted 99,9% to assist the P.E. Branch, with no strings attached. The Chairman said that in the Council minutes some mention was made of sponsorship of the smaller Branches as expenses were very high, but the Chairman said that the 1984 AGM was not going to cost the delegates as much as the last AGM.

The Chairman stated that the Algoa Flying Club were to stage a Navigation exercise on the last Saturday of the month and had asked for a radio link up, and had also promised to donate R50 to AGM funds. 7 people would be needed to assist and the following agreed: Trevor 2AE, Athol, Dick, Colin, Brian ZS2AB and Marge. Various others who were not at the meeting would also be asked to help.

With regard to the Hobbies Fair the Branch had been allocated a double stand and it was essential that we put on a good show to advertise the hobby, and promote ham radio as a whole and not just one branch. Help would be needed to erect the stall and to operate. The Chairman promised the use of his HF and VHF rigs and several members offered their help. Sam ZS2SI was available on the Wednesday and Fred ZS2JS and Roy ZS2RN also volunteered.

It was noted that 25th September was National Field Day and the Chairman suggested that we could get involved as a Branch.

Congratulations were extended to ZS2RM and ZS2OB for their success in the cw and ssb contests.

The Chairman said that he was very sorry, on behalf of himself and the Branch to have to wish farewell to Brian ZS2TY and Sheila ZS2BF who were leaving for Div 6 and to Peter ZS2PS who was going to Div 5 and wished them luck and success in the future.

Congratulations were extended to Cyril ZS2KX on attaining 80 years of age and to Bette ZS2LO for her birthday on 20th. Bette said she wasn't 80, though.

Continued on Page 5

technical

Continuation and completion of last month's article on regulated power supplies.

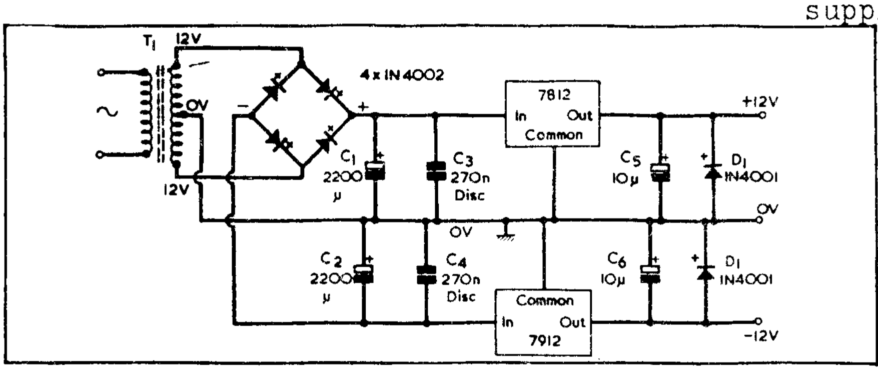


Figure 13: Complete circuit of a 12 volt 1 amp dual power supply using 3-terminal regulator IC's.

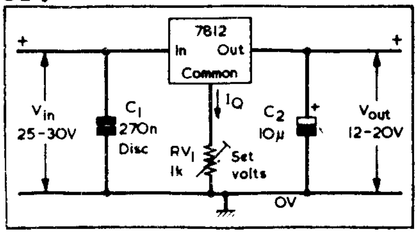


Figure 14: Very simple method of varying the output voltage of a 3-terminal regulator.

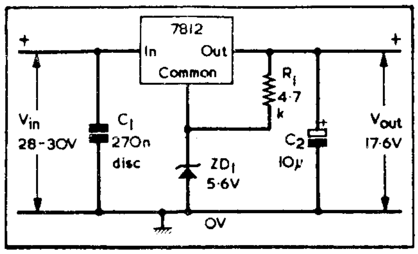


Figure 16: The output voltage of a 3-terminal regulator can be increased by wiring a suitable Zener diode in series with the common terminal.

The Filter Capacitor

The purpose of the filter capacitor is to convert the full-wave rectified signal of the rectifier into a smooth DC output voltage. The two most important parameters of the capacitor are its working voltage and its capacitance value. The working voltage must be greater than the off-load output voltage of the power supply circuit. The capacitance value determines the amount of ripple that will appear on the DC voltage when current is being drawn from the circuit.

As a rule of thumb, in a full-wave rectified power supply operating from a 50-60Hz power line, an output load current of 100mA will cause a ripple waveform of about 700mV pk-to-pk to be developed from a 1000u filter capacitor, the amount of ripple being directly proportional to the load current and inversely proportional to the capacitance value, as shown in the design guide of *Figure 6*. In most practical applications, the ripple should be kept below 1-1.5 volts pk-to-pk under full load conditions. If very low ripple is required, the basic power supply can be used to feed a 3-terminal voltage regulator, which can easily reduce the ripple by a factor of 60dB or so at very low cost.

Voltage Regulator circuits

Voltage regulators may vary from simple Zener-based circuits designed to provide load currents up to only a few mA, to fixed-voltage high-current circuits designed around 'fixed' 3-terminal regulator IC's, or to variable-voltage high-current circuits designed around 'variable' 3-terminal regulator IC's. We'll look at practical versions of all three types of circuit in the next couple of pages.

Zener-based circuits

A Zener diode can be used to simply produce a fixed reference voltage by using the connections shown in *Figure 7*. Here, a current of roughly 5mA is passed through the Zener diode from the supply line via limiting resistor R. Often, the supply voltage (V_{in}) may be subject to fairly wide variations, causing the Zener current to vary over a similarly large range. So long as V_{in} is always more than a few volts greater than the Zener voltage and provided that the Zener power rating is not exceeded, this variation has only a moderate influence on the output voltage of the Zener, which typically has an effective output impedance of only a few tens of ohms.

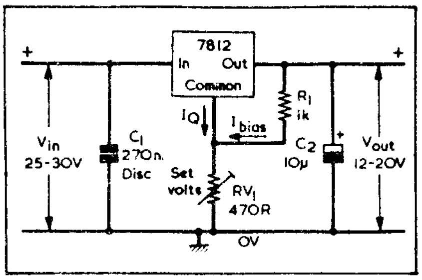


Figure 15: An improved method of varying the output voltage of a 3-terminal regulator.

A Zener can be used as a very simple voltage regulator, providing maximum load currents up to a few tens of mA, by merely selecting the value of 'R' as shown in *Figure 8*. Here, when the designed maximum load current is being drawn only 5mA flows through the Zener: When zero load current is being drawn the Zener passes 5mA plus the full maximum designed load current and thus dissipates maximum power: It is important to ensure that the power rating of the Zener is not exceeded under this 'no load' condition.

In most practical voltage regulator applications the Zener is simply used to apply a 'reference' voltage to a high-gain non-inverting buffer amplifier, which then supplies the required output power. The simplest example of this type of circuit is shown in the series-pass regulator circuit of *Figure 9*. Here, Q1 is wired as a voltage follower, its emitter remaining at about 600mV below its Zener-defined base voltage under all load conditions. The Zener network provides the base drive current to Q1, this current being equal to the output load current divided by the current gain of the Q1 'buffer' stage. Clearly, the higher the gain of Q1, the better will be the output regulation of the circuit.

One way of improving the regulation of the *Figure 9* circuit would be to use a Darlington or Super-Alpha pair of transistors in place of Q1. An even better solution is to use the op-amp plus transistor buffer stage shown in *Figure 10*. Here, the op-amp and Q1 are wired as a unity-gain non-inverting DC amplifier with a near-infinite input impedance and near-zero output impedance. The output voltage tracks within a few mV of the Zener reference value. The safe output current is limited to about 100mA by the power rating of Q1: Higher currents can be obtained if Q1 is replaced with a power Darlington transistor.

The *Figure 10* circuit is very versatile. It can be made to generate any desired fixed voltage up to about 30V maximum by simply using a suitable Zener value and ensuring that the unregulated supply voltage is at least 5 volts greater than the Zener value (up to 36 volts maximum). The circuit can be used as a variable-voltage supply by simply wiring a pot

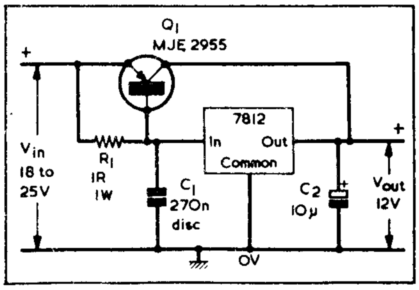


Figure 17: The output current capacity of a 3-terminal regulator can be boosted via an external transistor. This circuit can supply 5 amps at a regulated 12 volts.

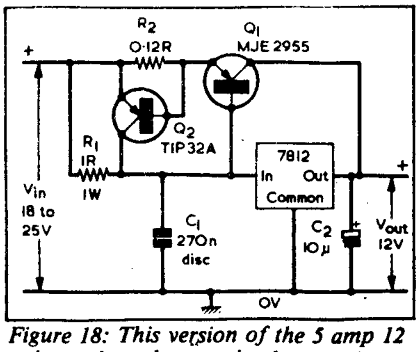
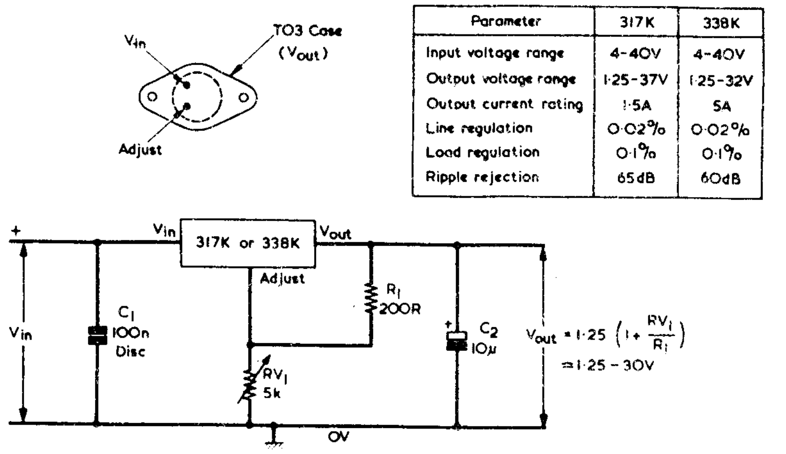


Figure 18: This version of the 5 amp 12 volt regulator has overload protection provided via Q2.



Parameter	317K	338K
Input voltage range	4-40V	4-40V
Output voltage range	1·25-37V	1·25-32V
Output current rating	1·5A	5A
Line regulation	0·02%	0·02%
Load regulation	0·1%	0·1%
Ripple rejection	65dB	60dB

Figure 19: Outline basic data and basic application circuit of the 317k and 338k variable-voltage 3-terminal regulators.

across the Zener, with its slider taken to the non-inverting input of the 3140 op-amp: This op-amp can accept inputs all the way down to zero volts, enabling (for example) a 0.25V supply to be easily implemented.

'Fixed' 3-terminal regulator circuits

Fixed-voltage regulator design has been greatly simplified in recent years by the introduction of 3-terminal regulator IC's such as the '78xx' series of positive regulators and the '79xx' series of negative regulators. These IC's incorporate features such as built-in fold-back current limiting and thermal protection. A wide range of 3-terminal fixed-voltage regulator IC's are available: Standard current ratings are 100mA, 500mA, 1A and 3A and standard output voltage ranges are 5V, 6V, 8V, 12V, 15V, 18V and 24V.

Three-terminal regulators are remarkably easy to use, as shown in the basic circuits of *Figures 11* to *13*, which show the connections for making positive, negative and dual regulator circuits respectively: The IC's shown in these examples are 12V units with current ratings of 1A, but the basic circuits are valid for all other voltage ratings, provided that the unregulated input voltage is at least 3 volts greater than the desired output voltage. Note that a 270n or greater disc (ceramic) capacitor should be connected close to the input terminal of the IC and 10u or greater electrolytic to the output. Also note that these regulator IC's typically provide about 60dB of ripple rejection, so 1 volt of input ripple will appear as a mere 1mV of ripple on the regulated output.

The output voltage of a 3-terminal regulator is referenced to the 'common' terminal of the IC, which is normally (but not necessarily) grounded: Most regulator IC's draw quiescent currents of only a few mA, which flow to ground via this 'common' terminal. The regulator output voltage can thus easily be raised above the designed value by simply biasing the 'common' terminal with a suitable

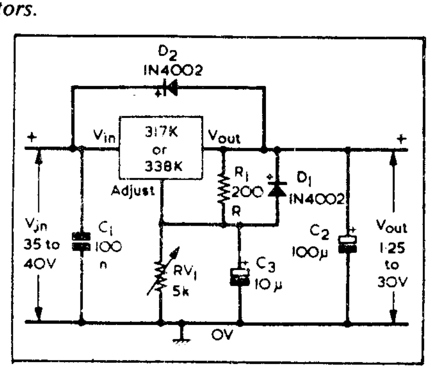


Figure 20: This version of the variable voltage regulator has 80dB of ripple rejection.

voltage, making it easy to obtain 'odd-ball' output voltages from the regulator. *Figures 14* to *16* show three ways of achieving this.

In *Figure 14* the bias voltage is obtained by passing the IC's quiescent current (typically about 8mA) through RV1. This design is adequate in most applications, although the output voltage obviously shifts slightly with changes in quiescent current. The effects of such changes can be minimised by using the circuit of *Figure 15*, in which the RV1 bias voltage is determined by the sum of the quiescent current and the bias current set by R1 (12mA in this example). If a fixed output voltage is required other than the designed value, it can be obtained by wiring a Zener diode in series with the common terminal as shown in *Figure 16*, the output voltage then being equal to the sum of the Zener and regulator voltages.

The output current capability of a 3-terminal regulator can be increased by using the circuit of *Figure 17*. R1 is wired in series with the regulator IC. At low currents insufficient voltage is developed across R1 to turn Q1 on, so all the load current is provided by the IC. At currents of 600mA, or greater, sufficient voltage (600mV) is developed across R1 to turn Q1 on, so Q1 provides all currents in excess of 600mA.

Finally, *Figure 18* shows how the by-pass transistor of the above circuit can be provided with overload current limiting via 0.12 ohm current-sensing resistor R2 and turn-off transistor Q2.

'Variable' 3-terminal regulator circuits

We've already seen that the outputs of '78xx' regulators can be varied over limited ranges by simply applying suitable variable voltages to their 'common' terminals, even though these IC's are designed as 'fixed' regulators. If, however, you need to vary the output voltages over fairly wide ranges, a far better solution is to use one of the special 'variable' 3-terminal regulator IC's, such as the 317k or the 338k.

Figure 19 shows the outline, basic data and the basic variable-regulator circuit that is applicable to these two devices. Both devices have built-in fold-back current limiting and thermal protection and are housed in TO3 steel packages, the major difference between the devices being that the 317k has a 1.5 amp current rating compared to the 5 amp rating of the 338k. The major feature of both devices is that their 'output' terminals are always 1.25 volts above their 'adjust' terminals, and their quiescent or adjust-terminal currents are a mere 50uA or so.

Thus, in the *Figure 19* circuit, the 1.25 volt difference between the 'adjust' and 'output' terminals causes several mA to flow to ground via RV1, thereby causing a variable 'adjust' voltage to be developed across RV1 and applied to the 'adjust' terminal. In practice, the output of the *Figure 19* circuit can be varied over the approximate range 1.25 to 33 volts via RV1, provided that the unregulated input voltage is at least 3V greater than the required maximum output voltage. Naturally, alternative voltage ranges can be obtained by giving R1 and/or RV1 alternative values, but it should be noted that for best stability the R1 current must be at least 3.5mA.

The basic *Figure 19* circuit can be usefully modified in a number of ways. The basic ripple rejection factor of this circuit, for example is about 65dB, but this can be increased to 80dB by wiring a 10u by-pass capacitor across RV1, as shown in *Figure 20*, together with a protection diode connected as indicated, to prevent the capacitor discharging into the IC if the regulator output is short-circuited.

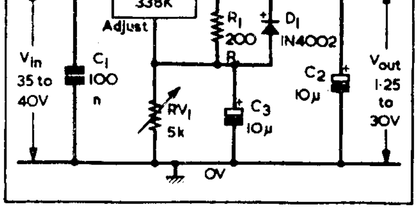


Figure 21: This version of the regulator has 80dB ripple rejection, a low impedance transient response, and full input and output short-circuit protection.

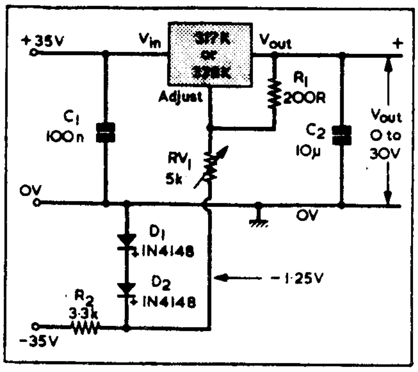


Figure 22: The output of this version of the regulator is fully variable from zero to 30volts.

A further modification of the *Figure 20* circuit is shown in *Figure 21*. Here, the transient output impedance of the regulator is reduced by increasing the C2 value to 100u; diode D2 is used to protect the IC against damage from the stored energy of this capacitor if an input short occurs.

The minimum output voltage of the *Figure 19* to *21* circuits is 1.25 volts. If you want the voltage to vary all the way down to zero, the circuits must be configured so that the 'adjust' terminal goes to —1.25V when RV1 is reduced to zero ohms. *Figure 22* shows how this can be achieved, using a 35V negative rail and a pair of series-connected diodes to clamp the low end of RV1 to —1.25V.

If you want to get the maximum possible voltage out of one of these regulators, you'll need to make sure that the input voltage does not exceed the 40V rating of the IC. The best way to do this is to use a simple Darlington-plus-zener pre-regulator circuit, as shown in *Figure 23*, which enables you to use any unregulated input in the range 35-55 volts. Note that as well as giving input over-voltage protection, this pre-regulator also gives a further improvement in ripple rejection. If you want to use this circuit with a 5 amp 338k regulator, you may need to reduce the value of R1 and beef up the power rating of the Zener diode.

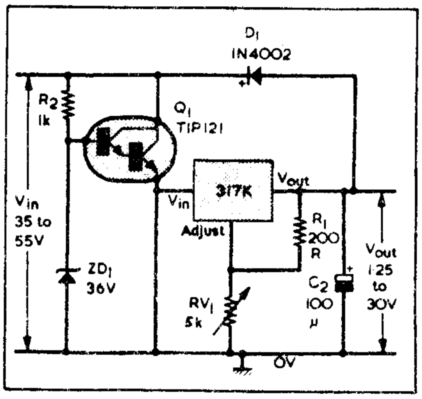


Figure 23: This variable-voltage unit uses a pre-regulator (Q1) to give input over-voltage protection and improved ripple rejection.

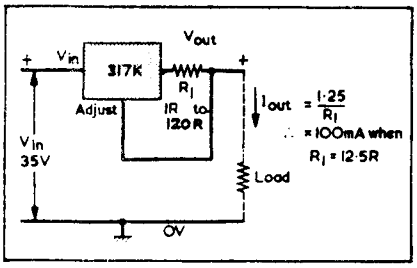


Figure 24: Method of using the 317k as a precision current limiter or constant-current generator.

Finally, to complete this look at regulator circuits, *Figure 24* shows how you can use the 317k as a precision current limiter or constant current generator in which the output current is determined by R1 and is virtually independent of the external load values. By suitable choice of R1, the constant-current magnitude can be set at any value between approximately 10mA (R1 equals 120R) and 1.25A (R1 equals 1R0). Not bad for a two-component circuit. ■

Continuation of Minutes from Page 2.

A special cake commemorating the occasions was brought to the meeting and a photograph taken of Cyril, Brian, Sheil and Peter was taken.
At this stage, the Chairman apologised for not having mentioned it at the beginning of the meeting, but informed members of the death of Ken Bradley ZS2HI who had been a member of the Branch for about 30 years until the time of his illness. Ken had been a very keen cw operator and dx hunter on the lower bands and those present stood in silence in his memory. Condolences were offered to his family and friends.
Fred and Cyril thanked the Branch for the birthday cards received.

There being no further business, the meeting was closed and the three cases of canned goods donated by Geoff ZS2GJ were sold. All tins were sold for 25c each and a total of R18 was raised towards Branch funds.

sgd:
R.W. Schönborn ZS2RS
Chairman

sgd:
M.T. Weller ZS2OB
Secretary

Just Hafta Get Myself a Hobby . . .

In Cyborg, Morty had finally found the ultimate station accessory.

By John A. Hansen,* WAØPTV

Being basically a nuts-and-bolts type of ham, I've always been amazed by Morty, KØQRM, who lives around the corner. I'm sure everbody's met a Morty at one time or another. He's the sort of guy who has to have every new gadget as soon as it hits the market. You know the kind. In 1968 he paid $130 for a pocket calculator that could only add and subtract. A few years later he paid $300 for an LED digital watch.

This insatiable hunger for the novel followed Morty into Amateur Radio in the mid-'60s. He immediately bought himself a complete S-line, but soon lost interest in it when Signal/One introduced its transceiver that required no tune-up. He must have bought 15 keyers in the last 15 years, as iambic keying, memory capacity, speed readouts, and so on, were introduced. Finally he gave up on keyers altogether and bought a microcomputer and interface for his rig. Money was no object to Morty; if the gizmo did something new, that was enough; he had to have at least a pair of 'em.

I hadn't heard Morty on the bands for several months. This is often a bad sign -- generally it coincides with the installation of a major new piece of gear. Finally, my curiosity got the best of me and I decided to stroll around the block to see what he was up to. From the outside of his house everything looked perfectly normal. His 180-foot, crank-up, fold-over, broadcast tower was there just as always, with its stacked Yagi monobanders and 4-element 40-meter quad. It didn't look like he was planning another enlargement of the 24-foot EME dish, either. No; whatever it was that was keeping him off the air must be inside the house.

I rang the bell, and it was a good 15 minutes before I got an answer (I've come to expect this). Eventually Morty appeared. Was he ever excited!

"Hey, OM, it's been quite a while. You're just in time to help me try out my new Cyborg 300 Universal Ham Interface! Come on down to the shack."

I learned a long time ago that with Morty an invitation like this was not to be turned down. So I followed Morty into the suite of radio rooms. When we reached the primary shack, he pointed to a large green and gray box with one switch. It appeared to be hooked up to everything in the room, including the transceivers, the microcomputer, the Teletype, the TV equipment and all their control devices.

"This is the Cyborg 3000 Universal Ham Interface," Morty announced. "It controls all of the station's operations with the flick of a switch. You merely program it once through the microcomputer, and you never have to go into the shack again."

"Really?" I must have seemed a bit skeptical.

"Absolutely," Morty replied. "It scans the bands, makes contacts, logs them and, when my automatic postage meter arrives next month, it'll automatically send out QSL cards."

"But don't people resent having QSOs with a machine?"

"That's the beautiful part," he said. "No one ever knows. QSOs these days have become so standardized that it's a very simple matter to program in a relatively few instructions to handle every contingency. For example, if someone says he or she is using an old Galaxy V transceiver, the Cyborg comments on what a good receiver it had for that vintage, and what a shame it is that Galaxy went out of business. Cyborg then offers to send a few useful circuit modifications."

"Amazing, but doesn't this put a certain distance between you and your equipment?"

"Well," Morty confided, "to be honest, I was somewhat concerned about that. So I called the manufacturer and asked for a Cyborg in kit form. They told me that they'd originally offered the interface as a kit, but, every time they mailed one out, it had assembled itself in the shipping crate by the time it reached its new owner."

He flipped the switch, and the whole room came to life as the machine scanned the bands, made contacts and logged all the pertinent information. Morty and I went out for a few beers.

As the weeks passed, it became clear that Cyborg was indeed working just as Morty said it would. KØQRM was on the air almost 24 hours a day. Whenever rare DX showed up, Morty (that is, Cyborg) was always right there to bag it. Morty won the ARRL CW DX Contest from his home QTH while he was on a vacation in the Bahamas.

What was more impressive, though, was that everyone said Morty had suddenly become a more interesting conversationalist on the air. It seems he'd leased an AP Teletype line and had run it into the Cyborg as well. The machine would cull the headlines to be on top of any topic that might be mentioned during a QSO. Morty easily earned the Rag Chewers Club Award, a distinction that had eluded him throughout his previous 15 years as a ham.

A few weeks later, when I was on the air with my home-built, 10-watt peanut whistle, I heard a knock on the door. I signed off and found Morty standing on my doorstep.

"How's it going?" I asked.

"Oh, okay, I guess," he replied.

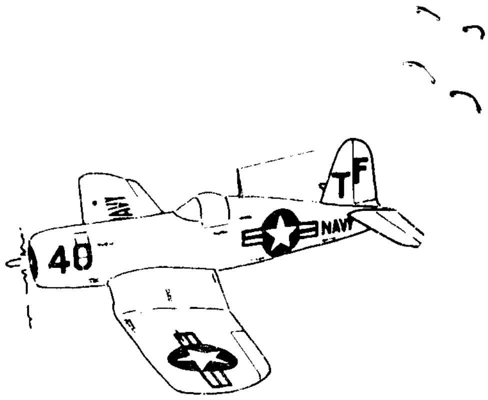
"Okay nothing! You're working an AC4 right now that I've been after for the last month!"

"Yeah, Cyborg does a heck of a job. Only trouble is, I've got so much free time now. . . I'm just gonna hafta get myself a hobby!" QST

The author, an economist, is a research associate at the Center for Policy Alternatives, Massachusetts Institute of Technology. A ham for the past 15 years, Dr. Hansen spends most of his time on the air DXing and ragchewing.

*38 Orkney Rd., No. 6, Brighton, MA 02146

DON'T FLY AROUND WITH FLY BY NIGHT OPERATIONS.



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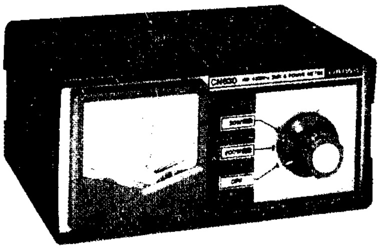
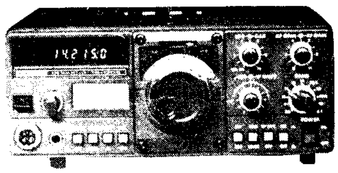


CN-630

SWR & Power Meter
Model CN-630

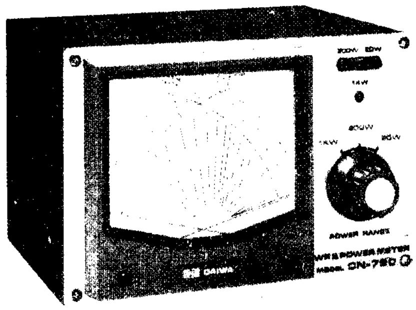
Simultaneous direct reading SWR, Forward Power and Reflected Power.

Frequency Range: 140—450 MHz
SWR Detection Sensitivity: 5 Watts min.
Power: 2 Ranges (Forward, 20/200 Watts)
(Reflected, 4/40 Watts)
Tolerance ± 10% full scale
Input/output Impedance: 50 Ohms
Connectors: SO-239
Dimensions: 180 x 85 x 120 mm;
7.12 x 3.37 x 4.75 in.

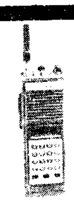


KENWOOD TS-130S

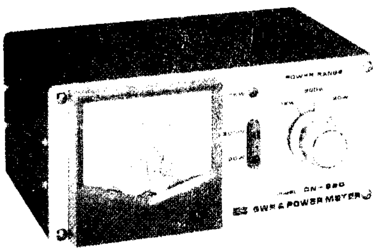
CN-720



SAVE MONEY



KENWOOD TR-2400

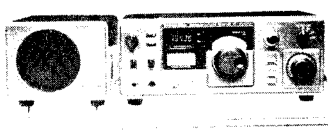


CN-620

SWR & Power Meters
Models CN-720 and CN-620

Simultaneous direct reading SWR, Forward Power and Reflected Power

Frequency Range: 1.8—150 MHz
SWR Detection Sensitivity: 5 Watts min.
Power: 3 Ranges (Forward, 20/200/1000 Watts)
(Reflected, 4/40/200 Watts)
Tolerance: ± 10% full scale
Input/output Impedance: 50 Ohms
Connectors: SO-239
Dimensions: 180 x 120 x 130 mm;
7 x 4.75 x 5 in.
165 x 75 x 97 mm;
6.5 x 3 x 4 in.



KENWOOD R-1000

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