CQ TV

NOVEMBER 1970

72

THE JOURNAL OF BATC

THE BRITISH AMATEUR TELEVISION CLUB.

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COVER PHOTO Churchill College, Cambridge

EDITORIAL

We print this time, the second part of Arthur Critchley's series on Integrated Circuits for amateur use. Part 1 last time aroused considerable interest, so after Arthur's recent lecture at CAT-70 I know many of you will be looking forward to this instalment. It could have been longer, but the report on CAT-70 took up the room, so the next part, in C Q - T V 73 will be even larger! Our thanks must go to Arthur for all the hard work he has put into this series - I know it's appreciated.

A full report on CAT-70 appears on another page of this issue, but those of you who were there will know already what a great success it was. Special thanks must go to the organising committee of Don Reid, Grant Dixon and Ian Waters who gave so much of their time to the Convention; that it was so much of a success is largely due to those three. Don Reid, who retired as P.R.O. after the A.G.M., has become identified with B.A.T.C. Conventions and this was no exception - many thanks, Don!

The other member of the committee to retire this year, as well as Don Reid, was Malcolm Sparrow. After six years as treasurer, Malcolm has contributed tremendously to the Club, and is responsible for giving the Club it's present financial stable condition. We all owe G6KQJ/T a great debt of gratitude and hope he will long remain associated with B.A.T.C.

To keep ourselves up to date, we've just had a new membership application form and general information sheet printed - on pink paper this time! You probably remember that the old one was blue. So if you know of any possible new members, drop the Secretary a line (his address is on page 1) and ask for a few copies of the new pink membership forms. May be useful to have a few around if you belong to any local clubs; someone, someday, may want to join the B.A.T.C.

Portsmouth Polytechnic are currently doing a lot to arouse interest in ATV in Southern England, and are now planning a series of lectures specifically aimed at amateurs. Anyone who would like to go along, or find out Portsmouth's programme, drop a line to:

The Secretary, Electropol,
Students Union Offices,
Union House, St. Pauls Road,
Portsmouth, Hampshire.

and be in at the beginning of the S. England regional A.T.V. centre.

THE EDITOR.

S U B S C R I P T I O N S

When your B.A.T.C. subscription expires, you automatically receive a subscription renewal form with the next issue of C Q - T V.

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So next time YOU receive a renewal notice, please return it straight away. And even if you don't intend rejoining, let us know to save us writing to you again.

Please help us to help you.

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Andrew Mellons G6AER/T became licensed a few months ago and since then has been working on his own colour tv station. Having now joined B.A.T.C., Andrew would like to know if anyone else in his area can transmit colour - to date he has seen no one! So anyone in the Dorking, Surrey, area who has colour gear - contact Andrew.

Harold Jones G6ABC/T G5ZT from Plymouth, Devon, writes to tell us of his activity with G6AFN/T, the only other /T within 50 miles at the moment. However, two-way video contacts are possible, and Harold hopes that quite soon G3XAW will aquire a G6 licence, when Devon should see some amateur telecine on the air.

POSTBAG

D.A. Nunn ZL1 AKG of Kawerau, New Zealand is another "Down Under" SSTV enthusiast. He mentions seven or eight slow-scan monitors being constructed by ZLICJ, ZLIAOY, ZLINH and many others. Transistorised circuitry has been developed to suit local components, and the use of EHT transformers from old tv sets seems popular for the new monitors (usually using 5FP7 or CVI397). F.S.S. s have been built by several people, and vidicon cameras should be appearing shortly. A regular net on 80m goes at 0800 and ZLIDW and ZLIAOY regularly receive pictures from all over the world on 14230KHz. New Zealand approved the operation of slow-scan on all bands in 1968 so the activity is quite widespread. The N.Z.A.R.T. magazine "Break-In" will shortly be publishing information on"the state of the art" in U.K. for the benefit of SSTV enthusiasts in New Zealand.

Jim Burnell-Jones VK2ZJV/T from New South Wales, Australia writes to say that, now the problems caused by getting married seem to be over, he can once more do some more work on Amateur tv. His camera in particular uses some cheap R.C.A. I.C.s and Jim is going to send details for publication in C Q - T V when tests are completed.

Harry Adams G3VZF of Twickenham has an advert in this issue for a RCA7183 storage tube. For those people interested in slow scan , Harry points out that this tube has distinct possibilities; anyone care to make him an offer for it?

Doug Ingham ZL2TAR of Lower Hutt, New Zealand, writes that he has started simple experiments with PAL colour on 70 cm. His PAL transmissions consist of colour bars, though most of the transmission time is taken up with film and live black and white. Can anyone help Doug with information on a source of dichroic mirrors for his camera?

Slow scan is not neglected either. Doug has a monitor and an electronic pattern generator, and is awaiting coils for a vidicon SSTV camera. The pattern generator can produce signals on the European or North American standards. It uses a master oscillator on 150Hz locked to the 50Hz mains, and divides by 9 or 10 to line frequency, depending on the standard selected. A divide by 120 chain follows, to produce field frequency. Drive pulses are thus provided for other equipment.

Doug also takes part in a SSTV net, which is active on 3650KHz Mondays and Thursdays, from 0730 to 0900, and finds there is usually someone around 14230KHz on Fridays and Saturdays (as does ZL1AKG, see his letter).

The main New Zealand ATV band extends from 421 to 449MHz, Doug tells us, enough for 4 "standard B" channels, together with another allocation at 23cm. ATV and SSTV operation in N.Z. is now included in the ordinary amateur licence with no special authorisation required. SSTV may be transmitted on any amateur telephony band, with the usual telephony bandwidth restrictions.

AN I.C. AMPLIFIER

By WA21CW/3

Reprinted from A5 Magazine

Many tv cameras which I have seen all seem to have one problem in common; they never seem to have sufficient video gain to drive some monitors, modulators or long cable runs without some loss of fidelity, or too much noise from being run wide open.

This problem has been solved at this QTH by the use of the amplifier shown in Fig. 1. The I.C. used is an R.C.A. type CA3020A. This device is capable of providing a bandwidth of 8MHz and a signal to noise ratio of 60dB down at the 1 volt level. In the circuit shown the a.c. output impedance of the amplifier is approximately 3 ohms. As an added **feature** it can provide both non-inverted and inverted outputs at the same time. The schematic shows a 9 volt supply, but a 12 volt supply should be used if larger output swings than 2 volts p to p are required, but it is recommended by R.C.A. that a clip on heat-sink should be used to provide cooling for the I.C.

If you would like to expand the use of this amplifier place a 10K resistor from the junction of the 4K7 resistor and the 5µF capacitor of p in 3 of the I.C. Place a 1µF capacitor from the other end of the 10K and run the capacitor to the top end of a 50K pot. Feed sync to the slider and you have a video sync mixer.

As a point of interest, the amplifier produces 1 volt p to p for an input of 0.15 volts, and the I.C. is available very cheaply from many distributors.

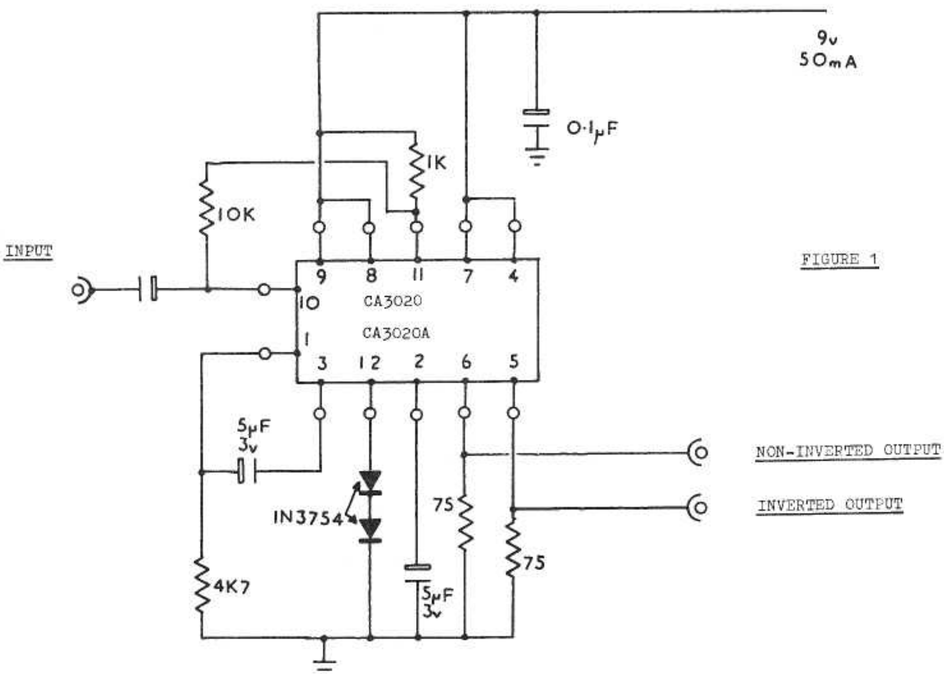


FIGURE 1

700mw TRANSISTOR TRANSMITTER.

By F. Eggermont ON5LM
Amateur Television Association - Belgium

The tv station which I use is basically simple and will enable any constructor to go on the air /T with success. The pilot transmitter is fully transistorised and supplies a full tv U.H.F. signal of 437.4 MHz of approximately 700mW. The output stage which is of conventional design and is equipped with QQE03/20 is capable of supplying about 8 watts to a 19 element antenna. Since this output stage can be any 70cm P.A. using class AB, we will not go into further details here.

The pilot transmitter, including the modulator, comprises only 9 transistors, all silicon.

Description of the pilot transmitter

This is crystal controlled and operates at a frequency of 437.4MHz. The choice of frequency was particularly determined by the possibility of adding, at a later stage, a phone channel at 431.9MHz, FM modulated, so that the CW-DX at 432 (moonbounce hi) will not

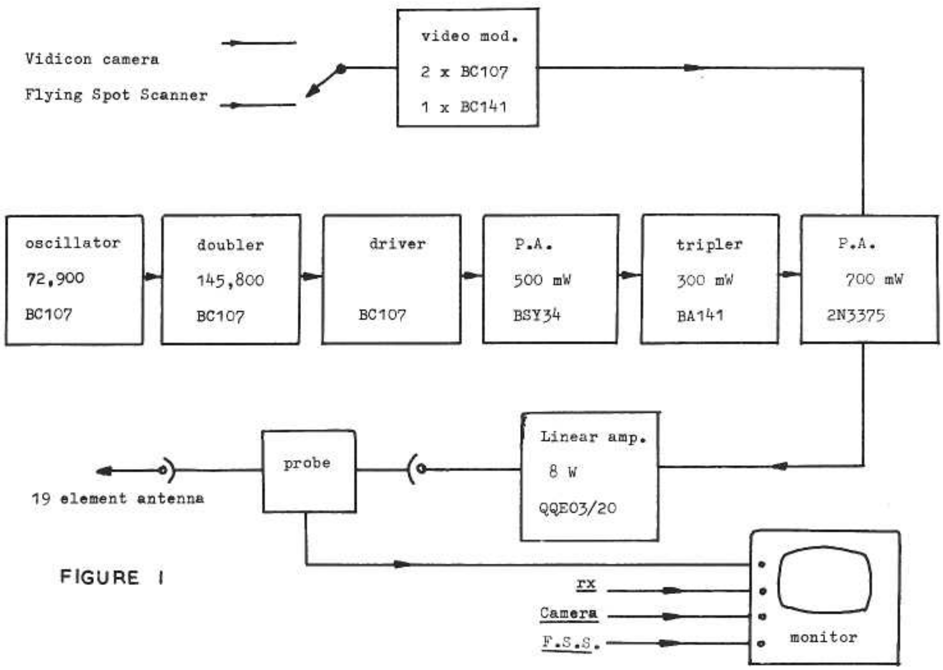
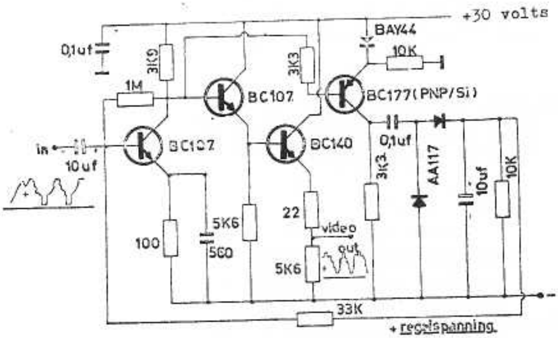


FIGURE 1



CIRCUIT NOTES

1. All r.f. coils 7 turns enamelled copper wire on ferroxcube core.

2. Coils in oscillator and doubler stages wound on 10mm formers with 0.9mm dia-wire.

3. Cp is 1.5cm insulated wire, twisted together.

4. Lp is 25mm length of wire 8mm above chassis.

5. Capacitors in p.f.; decimal figures in n.f.

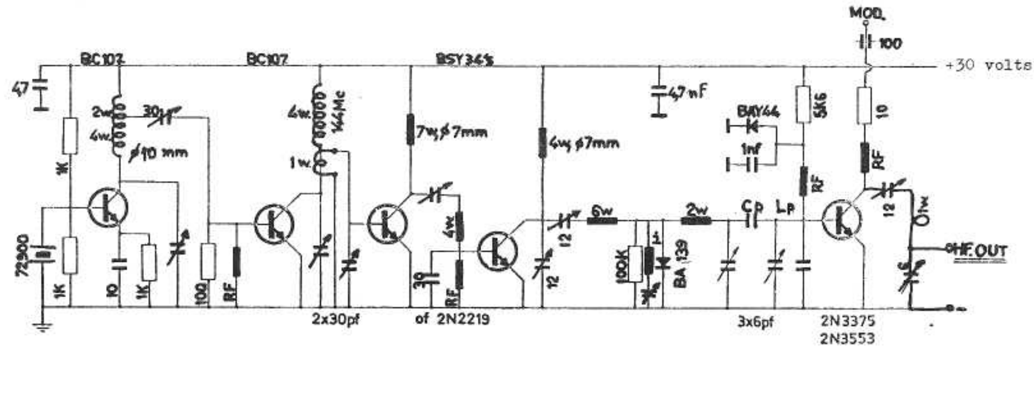
6. i is tuned to 288MHz, 3pf in series with 4 turns on ferroxcube core.

be subjected to interference. The oscillator operates with a 5th overtone crystal and uses a BC107, followed by a doubler also using a BC107. This is followed by a BSY34 which is coupled by means of transformer to the doubler, this being best for the 144MHz component required. Its output is a conventional filter which controls the base of the output stage for 144, also a BSY34. This is capable of delivering about 500mW output to the varicap-tripler, a BA139, which at a reasonable efficiency delivers a 70cm signal of about 300mW to the output stage, which uses a 2N3375. The latter is biased to class AB receiving a steady base current via a voltage divider with a resistance, which thereby stabilises the base at about 0.6volts.

The 2N3375 is modulated by a full video signal at the collector, and has a pi-filter in its output, which takes care of matching at the aerial (local noise free signals at up to 2km) or to the QQE03/20 arranged in class AB (steady current about 20 mA at 400 volts).

The video modulator

Also basically simple, this consists of only 4 transistors. T1 constitutes the amplifier stage proper and is intended to amplify x20 for 100% modulation. For compensation for the higher frequencies the emitter resistor was de-coupled by a 560 pf capacitor. The d.c. bias is set by the 1MΩ collector-base resistor, while a control voltage is taken from a detection circuit.



T2 and T3 are connected as a double emitter follower d.c. coupled from the collector of T1. The output of T3 controls the P.A. transistor 2N3375 with a protective resistor of 22Ω placed in series. T4 is a P.N.P. transistor and is switched by the video signal. A threshold voltage of 0.6 volts is set by D3 in the emitter so that the voltage to the base, in relation to the emitter, should be at least 1.2 volts, to make T4 conductive. Since its base is coupled to the collector of T1 via a resistor, the video output signal drops below 30 - 1.2 = 28.8 volts, T4 becomes conductive and the latter returns a voltage step via the diode circuit to the base of T1, so that this becomes more conductive and thus receives a correction automatically. Consequently, during the video period, operation is at a constant level. The transistor T4 therefore operates as a peak detector and controls the output voltage. The time constant was determined experimentally as 10µF and about 10KΩ.

Practical results

In conjunction with a 70cm 19 element aerial at about 9 metres above ground level, vidicon camera and a converted Grundig P1200 as a receiver (also monitor for transmission via an aerial probe) with a modified tv converter using an AF239 the following results were achieved:

one way with 5 local stations up to 10Km, noise free.
one way ON - G with G8AJC and G3LQR in Canterbury 8-3-69
one way ON - PA with PAOBON in Zierikzee
two way with G2WJ and G6NOX/T in Essex
Stations received noise free G6NOX/T
Stations received slight noise ON4RT, ON4LP, F9NJ
Noisy, but 100% Q5 ON4ZK, F9MF, G6ADK/T, G6ADZ/T

SLOW - SCA TELEVISION BIBLIOGRAPHY

The great interest in slow-scan television at the moment has prompted Ted Cohen to compile this bibliography of literature on SSTV. We print it here with thanks to Ted W4UMF for all the work he has put into it.

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A COMPACT FILTER FOR S & V

By Heinz G. Venhaus DC6MR

Reprinted by courtesy of "TV Amateur".

The filter described below serves to mix the outputs of picture and sound transmitters into a single 70cm antenna. The coaxial filter (60 Ω impedance) consists of four tuned circuits, and serves at the same time to reduce any 2 meter emissions as well as harmonics. In this way, clear reception of 2m. stations (e.g. a talkback circuit) is possible during tv transmissions.

Construction Start with a surplus U.H.F. convertor with $\frac{1}{2}\lambda$ circuits. All parts must be removed except the trimmer capacitors. To these trimmers are attached inductances L1 - L4, consisting of lengths of 1.4mm silvered copper wire. The coupling is made through the former spindle holes, the upper part of which must be soldered up.

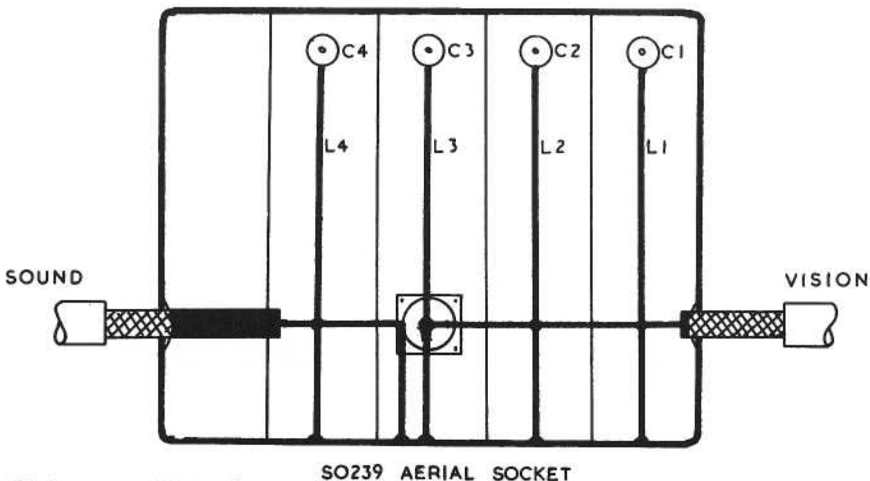

FIGURE 1.

All other holes must be made "RF proof" by soldering. The coaxial cable is brought in through small tubes to which the braiding is soldered. The inner insulation of the coax may be left in place to ensure that the inner conductor is properly centred. The aerial socket is soldered to the back of the box and connected directly to L3 (see Figure 1). The box may be closed with its original lid and copper foil.

Adjustment It is best to use a field strength meter which should be placed near the transmitter aerial. The sound circuit L4 C4 should be adjusted for maximum field strength. The picture trimmers C1 C2 and C3 are then adjusted for maximum field strength with no modulation. The sound and vision transmitters are then switched on and off in turn and the trimmers C1 - C3 are reduced in capacitance to give a slight attenuation of the picture carrier. By means of this procedure the bandpass curve is shaped so that the lower sideband up to 1MHz is sharply attenuated. The circuits then have a bandwidth of 10MHz; their resonant frequency is made, by the above tuning procedure, sensibly higher than that of the picture carrier. It is in this way that the lower sideband is clipped.

NOTE This method of combining two transmitter outputs is not so reliable as that described by Ian Waters in C Q - T V no. 66. It may be difficult to adjust, but does have the merit of simplicity and the author is to be commended on the ingenious use of a U.H.F. tuner.

CIRCUIT NOTEBOOK NO. 6

Step wedge and Grille Generator

By John Lawrence GW6JGA/T

In the Amateur T.V. Station it is useful to have a source of video signal, independant of the camera or scanner, which can be used for checking the operation of various parts of the system.

Suitable signals are a step wedge or staircase and a grille. The step wedge will enable the amplitude linearity of the transmitter to be checked, and the monitor and camera linearity can be checked using the grille.

It is convenient to combine the circuits of the two generators as a common multivibrator can then drive both the vertical line generator and the step generator.

The complete circuit of the step wedge and grille generator is shown in Fig. 1.

Line drive is fed to Tr1, which clips and distributes line pulse signals to the various parts of the circuit. The vertical bar multivibrator consists of Tr4 and Tr5 connected as an astable multivibrator, running at 8 times line frequency. The base current feed to Tr4, through R9, is turned off during the line pulse when Tr1 is bottomed, and is only present during the active line period when Tr1 Collector is at - 6 volts. This means that the timing of the output from the vertical bar multivibrator is synchronised to line frequency. The actual frequency, and thus the number of bars or steps, is set by RV2.

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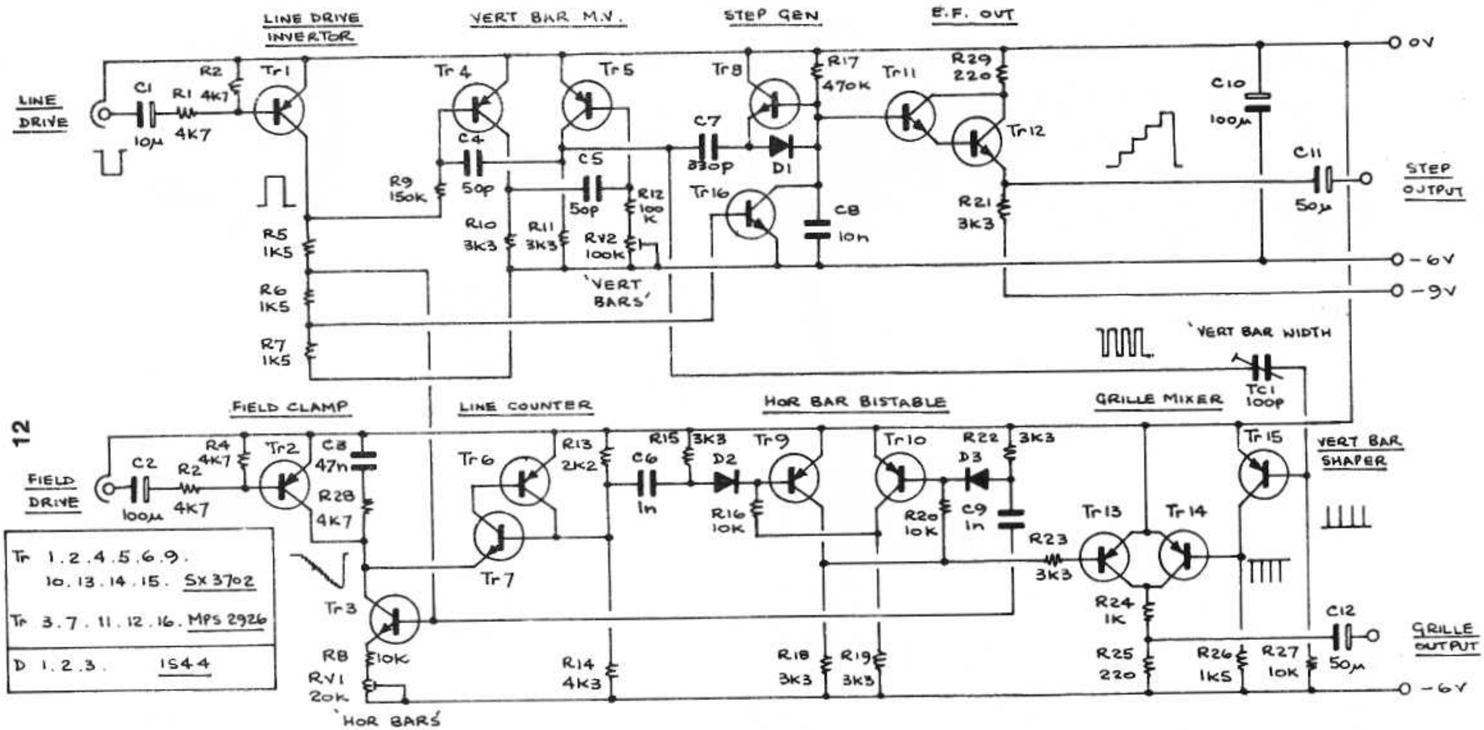
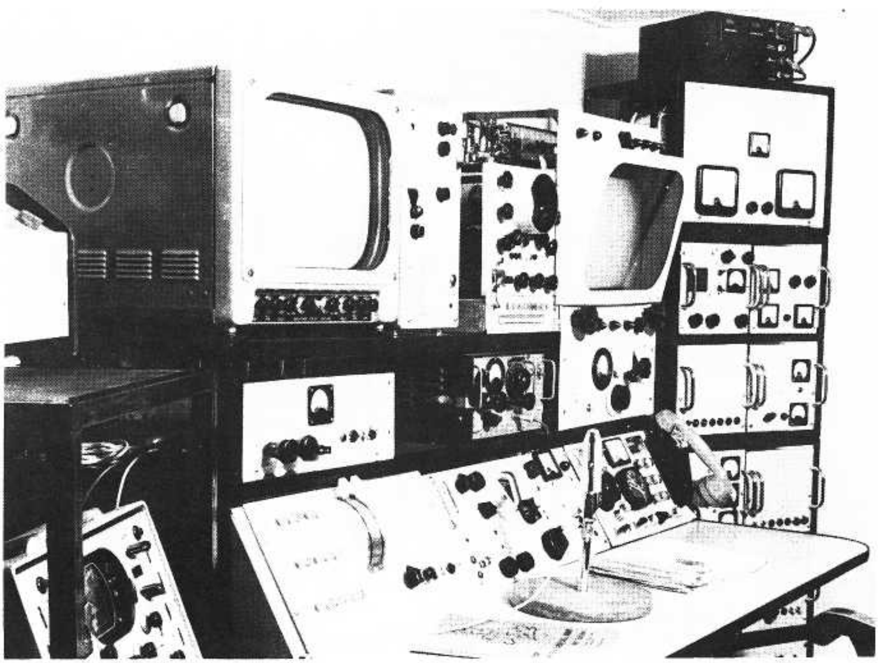


STEP WEDGE AND GRILLE GENERATOR

C A T

CHURCHILL COLL

CAMBRIDGE



G6KKD/T's Station near Cambridge

This was visited by many members on Saturday

· 7 0

GE

"Use or Lose" was the theme of the 21st birthday celebration of the B.A.T.C. at Churchill College. With reference, of course, to 70cm band at present used by /Ts. Again and again this was hammered home to us; by chairman, president, guests, Minpostel, so that everyone knew how tenuous our position was.

But this doesn't mean CAT-70 was a dismal affair. Far from it. The organising "committee of three" presented us with a swinging international Conference which will go down in history as a really BIG EVENT.

Throughout the weekend an Exhibition in the Pavilion was maintained, with varied amateur and professional stands. We must thank Pye TVT and EMI for being present, as well as the stalwart British and foreign amateurs who brought their gear along. Too long to list here unfortunately, but some of the photos will show what was there.

The first big get-together was a visit on Saturday morning, to the Pye TVT factory at Coldhams Lane. A 52 seater coach and a few cars took those interested, and a great many fascinating commercial products were seen. Thanks very much, Pye.

Saturday afternoon saw a very interesting and successful "over the air" demonstration of 70cm tv presented from the CAT-70 studio by Ian Waters. Staions in East Anglia contributed their own particular shows, and by means of the camera, gave us all a tour of their own stations. Those contributing were NOX/T at 14 miles distance, REH/T in Sutton St James 36 miles away, ADM/T whose QTH in Haddenham, 11 miles away was plagued by mains failures (not that it stopped him much), and AEV/T operating an OB on the river in Cambridge. One highlight was a relay of G6WJ/T, relayed to Churchill College via NOX/T in Saffron Walden - a 13 mile hop followed by a 14 mile one. As Ian Waters G6KKD/T was presenting the programme at Churchill, he recorded his own stations contribution on video tape and replayed this to the Conference - couldn't be in two places at once, he pointed out! Ian and his team worked very hard on this demonstration and are to be thanked for their efforts, which were highly professional in the face of considerable difficulties. They also worked the talk-in station G8DIY/A throughout the Conference.

This was followed by a film show, with professional films on colour c.r.ts by Mullard, I.Os and Klystrons by E.E.V. and the Post Office Tower by the GPO. Interspersed with light-hearted cartoons which amused everyone.

JULY 24 - 26

The Convention dinner took place on Saturday evening and was very well attended and generally voted a great success. Guests represented the B.A.T.C., BBC and ITA, RSGB, Pye, R.T.S., and EEV, as well as many other organisations. Afterwards Gordon Sharpley, the Chairman, officially greeted the overseas guests - from U.S.A., Belgium, France, Switzerland, Germany, Holland and S. Africa, and read a 21st birthday telegram from Mike Cox who was unable to be present. The President of B.A.T.C., Ivan James, spoke of the growth of amateur television in the Club's 21 years - from the initial 25 members to todays' 1,000. He mentioned how grateful we were to the early experimenters, to helpful manufacturers, to the R.S.G.B. for all the assistance which had made the Club possible. After exhorting us to make more use of the rf bands available to us. he offered the thanks of all present to the CAT-70 organising committee of Grant Dixon, Don Deid and Ian Waters who had worked so hard to make the Convention possible. Finally, the Master of Ceremonies, our old friend John Ware, called upon Grant Dixon to close the after-dinner speeches. As well as welcoming overseas visitors and making a plea for new committee members, Grant once again reiterated the "Use or Lose" cry about 70cm, which we were to hear so often throughout the Conference.

On Sunday morning most people gathered to hear lectures delivered in the Wolfson Hall. Grant Dixon spoke on SSTV, noting its history, its standards and the countries with the keenest adherents, and went on to show some practical circuits for slow scan use. He also mentioned the current interest in "watching" on 80m and 40m. Next, Arthur Critchley spoke on Digital I.C.s, telling us about the difference between RTL and TTL, in price, performance, availability and use, and showing us some uses of these devices. He finished by describing an I.C. Grille generator, to be written up in a forthcoming C Q - T V . The last lecture was delivered by Mr. M. Davies of the Ministry of Posts and Telecommunications on the subject of Amateur Licences. He described in a fascinating lecture the need for licences, and told us of the need for discipline over frequency allocation. Mentioning that there were 15,000 sound licences and 3,500 mobile, but only 181 television licences. He also told us that we must "Use or Lose". We have a very attractive band in 70cm, Mr. Davies told us, and unless we are seen to be using it other interests would be only too pleased to take over.

The lecture morning closed with Malcolm Sparrow thanking the lecturers for their efforts, especially Mr. Davies who had broken his holiday to come and speak to us.

The final event of the Convention on Sunday afternoon, was the Club's A.G.M. Gordon Sharpley, as retiring chairman, gave a resume of the events of the past two years; the delegation from B.A.T.C. to Armentieres, the fight for the retention of 70cm,and the need for new blood in the Club. He ended by thanking once again, all those involved in making CAT-70 a success.

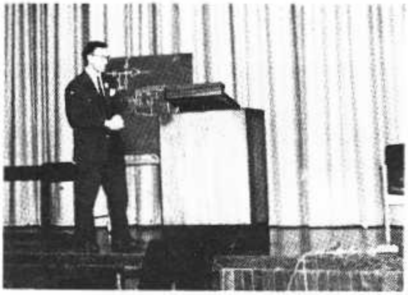
Ivan James, the President, expressed his appreciation of the organisation on the Convention and hoped to see everyone at the Swiss Amateur TV Convention in May 1971.

Malcolm Sparrow, the retiring treasurer, presented his last financial report, and explained the intricacy of it. His main point was to put a resolution to the A.G.M. requesting power for the committee to raise the Club subscriptions. to £1 IF NECESSARY. This was passed unanimously.

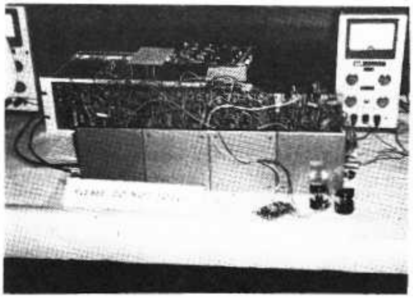
The Editor, Andy Hughes, made a plea for more articles (almost all he ever says when he speaks!) and Ian Waters spoke about a forthcoming meeting with the Ministry of Posts and Telecommunications on the subject of a new amateur tv license to be negotiated. Comments on this would be welcomed by Ian.

Grant Dixon then presented the prizes for the best exhibits in the Pavilion to John Lawrence and Herr Schaeffer of Germany.

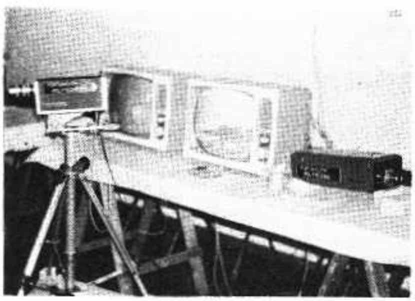
After this the meeting concluded with the election of a new committee, the results of which are printed on Page 1. This formally closed CAT-70, a memorable 21st birthday Convention to be remembered by us all long after the final home-going.



Arthur Critchley lecturing on Integrated Circuits



Arthur Critchley's Integrated Circuitry on, display; the tiny item foreground is a grille generator!

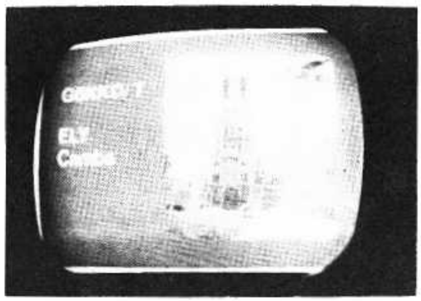


Portsmouth Polytechnic's Exhibition Display

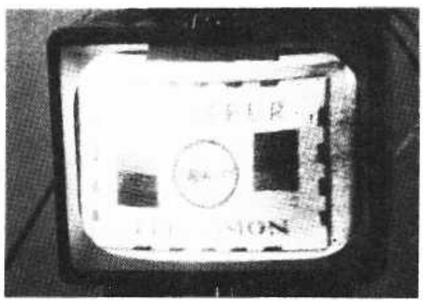
John Lawrence's Exhibition Display

Allan Pratt and camera in the CAT-70 studio

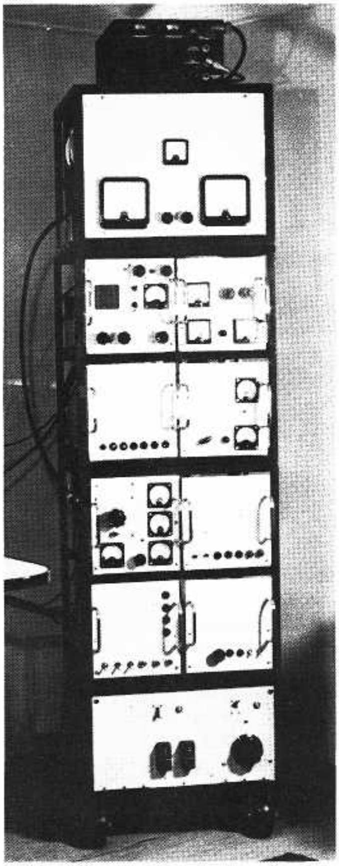
Jeremy Royle's off-air demo began like this



And Ian Waters identified himself like this



G6WJ/T relayed via G6NOX/T



The Transmitter at G6KKD/T; this was described over the air by Ian Waters, the builder

1970/71 COMMITTEE

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C. Chivers
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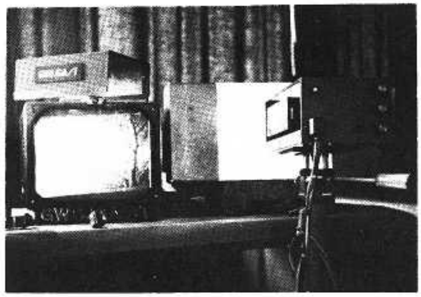
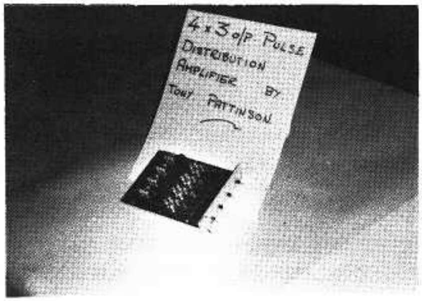


John Lawrence's Caption Scanner; this was part of his prize-winning display



Tony Pattinson's miniature rack-mounted P.D.A.

Jeremy Royle G6NOX/T talking over the air

INTEGRATED CIRCUITS

by: A.W. CRITCHLEY Dip. El., C. Eng., M.I.E.R.E.

USING R.T.L. DIGITAL INTEGRATED CIRCUITS
FOR T.V. PULSE GENERATION CIRCUITS

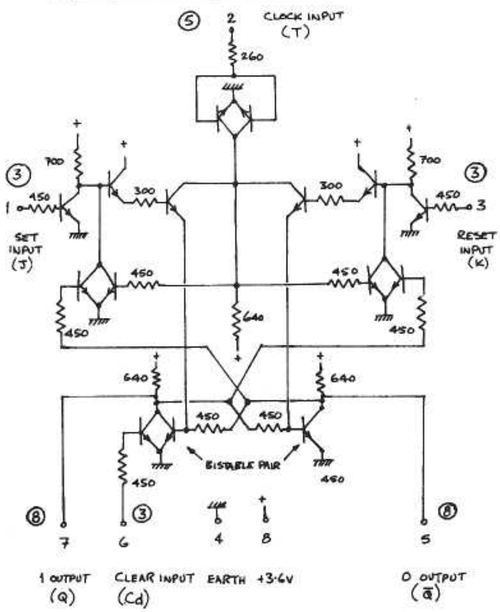
PART 2.

The μL 923 J-K BISTABLE

The previous part of this series discussed the μL900 & μL914. This article shows how the μL923 Bistable can be used to form S.P.G. counters and to directly form pulses such as Field drive, or Composite Syncs.

The μL923 is a bistable which contains all the necessary self-steering circuitry to make a binary counter, but it has some other features as well. Fig. 1. shows the internal circuitry of one μL923 (or ½ MC790P)(or MC723P) and it is indeed a fearsome sight.

Fig 1. μL 923 Internal Circuitry



Pin numbers are numbered anticlockwise from the top and the flat is pin 8. Note, that this convention is the same as that for valves although not obviously so.

If dual-in-line (MC700P series) IC's are used the pin numbering system is utterly different. Some other differences are that the output loadings are 10 and not 8, and certain resistances are different in value.

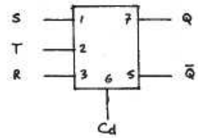
The Manufacturers' data refers to the inputs and outputs as R,T,S, Cd, 1 and 0. but in this article the 1 and 0 are referred to by the more common abbreviations of Q and Q̄. as fig. 1 shows. (To avoid confusion with logic symbols.)

Figure 2 is the Logic diagram of figure 1 and this is all we need to have if we remember the functions of the various inputs from figure 1.

Pins 4 and 8 are always earth and +3.6V respectively.

Pin 6, the Clear-input, if given a positive potential, will make the Q-output low irrespective of any other conditions at other inputs.

Fig 2
μL923

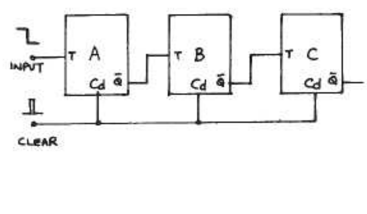


If pins 1 and 3 (S and R) are at a low potential then the bistable will clock on every negative-going edge at the T-input. These two inputs will not drive the bistable by themselves.

Pin 2, the Clock-pulse input, (T) feeds the bistable pair if S and R-inputs allow it to. There is a further internal self-steering action in order to get the toggle effect.

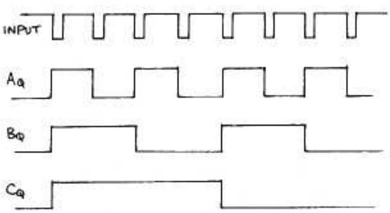
This enables us to make a simple cascade of bistables which forms a binary counter as in fig. 3. The waveforms of this are shown in figure 4.

Fig 3. Binary Counter



Note that the convention is for Q-waveforms to be given, so that the following bistable appears to be driven by a positive-going edge, but since $\bar{Q}$ is the inverse of Q, the negative-edge is actually doing the work.

Fig. 4. Waveforms for Binary Counter



Note also that the input clock-pulse to drive these bistables must be of 100 nS, or less, rise-time- any old pulse will not do.

Suitable driving sources are other bistables, schmitt-triggers, or one or more gates in cascade, or any other especially fast rise-time source.

A sine-wave source will need to be squared off.

Obviously any number of bistables can be cascaded to obtain a count of 2,4,8,16 etc. ----, 2^n; but the problems with Sync Pulse Generators involve counters of prime-number counts in order to obtain interlaced scanning. All the usual line standards for interlaced scanning are odd numbers which can be factorized into simple factors. e.g. $625 = 5 \times 5 \times 5 \times 5$, $405 = 5 \times 3 \times 3 \times 3 \times 3$, $525 = 5 \times 5 \times 3 \times 7$. The usual 'valve' way of obtaining odd, or prime-number counts was to feedback the output edge as another input pulse to reduce the count by one, or more, depending on the connections. The trouble with this is that the delay between input and feed-back limits the speed of counting and also that the output is not regular.

Modern bistable counters use the different approach of inhibition of the counter thus missing out an input-pulse change and therefore adding one, or more, to the count. To understand how this is done, the functions of S and R-inputs of the bistables have to be known.

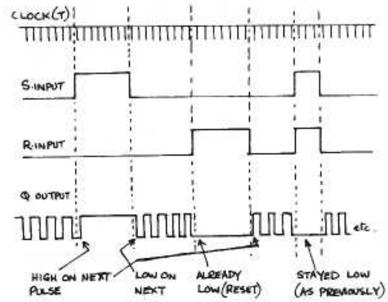
Set and Reset inputs

The S and R-inputs perform a preselection function. If the S-input is made 'high' then the bistable can be Set, but not Reset by the clock-pulses. In other words if the Q-output is low, the next T-pulse will make it high, but if it were already high, then it could not be made low. So the effect is that the bistable will eventually end up with Q high if it is not already there.

The R-input performs the exactly opposite function, and makes the Q-output Low (or $\bar{Q}$ high). Fig 5 shows this.

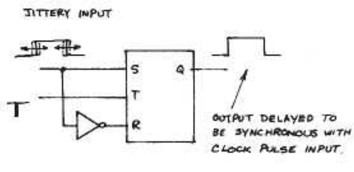
If both S and R are high, then the bistable will not change state at all whatever its present state - it is inhibited completely. (it can still be set Q-low by the Clear-input, pin 6, however).

Fig. 5 Action of S & R inputs



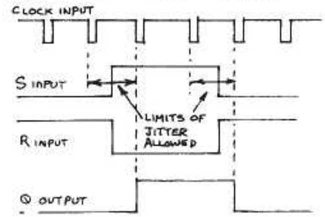
This preselection facility allows us a method of 'cleaning-up', or stabilizing, jittery waveforms, as figures 6 and 7 show. The bistable is clocked by accurately timed pulses which can be at the same frequency or much higher.

Fig 6. Stabilizing a waveform.



Such a situation may occur at the end of a chain of counters which have variable delays (Ripple counters, for example, of which more later). If a higher frequency clock pulse is used, then if the S and R inputs are made high and low such that they are always opposite then the Q-output duplicates the input waveform, but it has an accurate timing. There is a slight delay which is up to one h.f. C.P. interval. Provided that the S-input variation in delay does not exceed the clock pulse interval then the output will be stable in time.

Fig 7. Action of Circuit in Fig 6.



Counter types

However, from the Amateur T.V. point of view, the main use of the μL923 is in counters. There are two basic forms which are Synchronous and Non-Synchronous, or Ripple, Counters. Basically the Synchronous counters are more reliable & can be made, sometimes, to give particular waveforms but they have a high input loading as each bistable must be clocked simultaneously and so all T-inputs are paralleled.

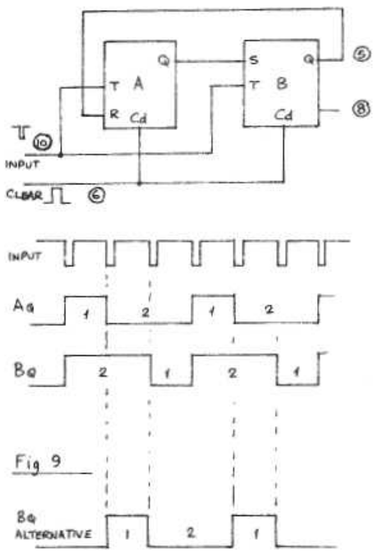
The Synchronous Counters have an input-to-output delay of that of one bistable only which is (for the µL923) 100 nS for positive-going outputs and 60 nS for negative outputs.

Ripple Counters may have a delay which is that of several stages in cascade. They usually have strange waveforms and sometimes will not start themselves. On the other hand, they have an input load of, at most, two bistables or 10 units. They are also generally cheaper to make and run as they do not usually have extra gates.

Suitable Counters for S.P.G's

Various types of Counter are now given together with comments on their performance, and suitability, Generally the simplest possible is shown.

Fig 8. ÷3 Synchronous Counter



This is the simplest odd-number counter, having only two interconnections. The clear inputs are not necessary unless a known starting condition is required; in most counters the Cd-inputs should simply be earthed (not left open-circuit as interference could have an effect). In the following counters the Cd-inputs will be omitted. The input and output loadings are shown in the circles.

The above counter may be wired with AQ to BR and BQ to AS if desired; this merely interchanges the A and B waveforms.

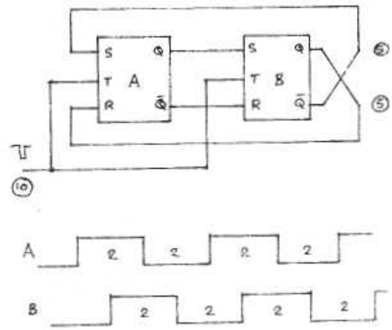
If the $\bar{Q}$-outputs are used instead of the Q-outputs and S and R also swopped in fig 8. the waveforms are both inverted.

If, in fig 8, A$\bar{Q}$ is joined to BR as well then the A waveform stays the same, but the B waveform is as shown in fig.9.

This may be more useful for some applications.

This counter now is almost a 'twisted-ring' or 'Johnson' counter, which is basically a chain of bistables fully inter-connected (fig 10.) where the last-to-first connections are crossed-over. The result is a square wave generating counter of a count twice the number of bistables.

Fig 10 ÷4 Twisted Ring Counter

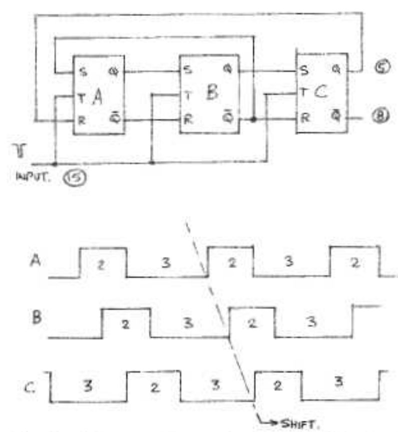


This is a very useful arrangement for S.P.G's because the decoding, is very simple, but this will be discussed later. Note the 'shift' of B, relative to A, by one pulse.

It will be seen that the ÷ 3 counter has one, or two, of the links missing and a simple switch could be added to change the count from 3 to 4.

Extending the principle gives a ÷ 6 counter and a ÷ 5 variation of it.

Fig. 11 ÷5 Synchronous Counter

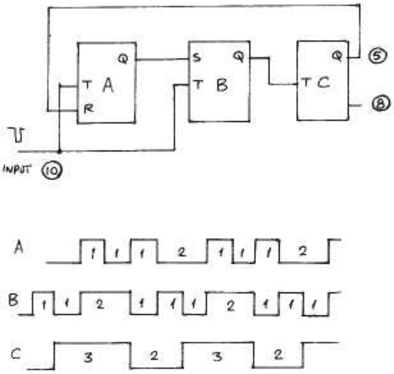


The C-output is negative-going for the 5th input pulse. To count 6 the AS-input is joined instead to C$\bar{Q}$.

Swopping AS and AR and their feeds from B$\bar{Q}$ and CQ to BQ and C$\bar{Q}$ inverts the waveforms as before. Also, as before, note the 'shift' as the waveform progresses down the counter.

Shift register counters sometimes have a snag in that if the bistables happen to take up arbitrary states at switch-on, the count is changed usually by a factor of two, or so. Clearing these counters is therefore often desirable before counting.

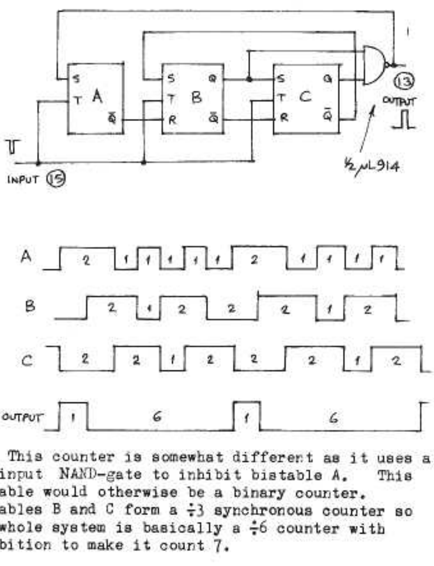
Fig 12. ÷5 Ripple Counter



This counter has less inter-connections than the one in fig 11. but has more irregular waveforms. Bistable C is clocked from Bistable B. so it has two bistable-delays.

The input loading is only 10 however. Both this circuit and that of fig 11 use nothing more than three bistables.

Fig 13 ÷ 7 Synchronous Counter (1)

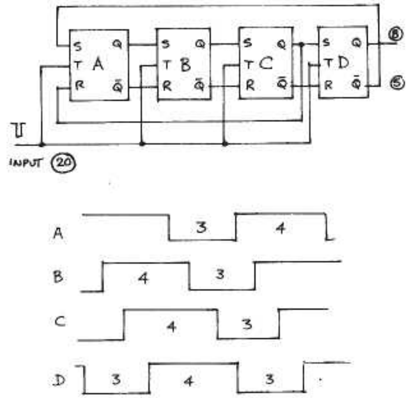


This counter is somewhat different as it uses a two-input NAND-gate to inhibit bistable A. This bistable would otherwise be a binary counter. Bistables B and C form a ÷3 synchronous counter so the whole system is basically a ÷6 counter with inhibition to make it count 7.

The gate output gives the final output.

This particular counter is self-starting under all conditions of switch-on state.

Fig 14 ÷7 Synchronous Counter (2)

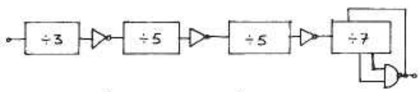


This synchronous ÷7 counter has a high input loading factor of 20 but can be driven by a μL923. It is a 'shift register' type as was the ÷5 and requires only a 2-input gate for decoding the outputs of any two bistables will do since the waveforms are all the same. This means that no thought need be given to the gating if just a single pulse is required-very useful for those who have difficulty in understanding counters.

Cascading the counters

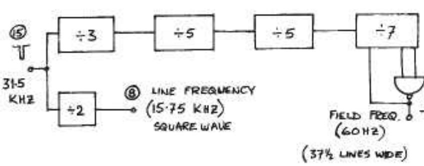
With these counters, any of the usual line-standards can be obtained. For example, the 525 system would be as shown in fig 15.

Fig 15. ÷525 Counter Chain



The buffer/invertors are ½ μL914 each. - the ÷3 counters not needing one.-in practice, the buffers can be neglected for Amateur work. So the final system would become as in fig 16.

Fig 16. Practical 525 Interlaced Counter



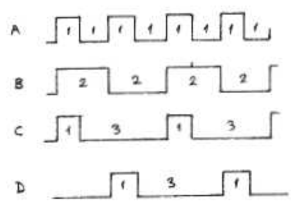
Decoding

This counter chain by itself is not much use although the frequencies are correct.

Accurate pulse widths can be obtained from this chain by a system of gating known as decoding.

Basically the problem is that the waveforms are complex as a rule, or at best have a useless mark-to-space ratio such as 2 to 3. Generally what is required is a mark-to-space ratio of 1 to (n-1) and this is achieved as follows:-

Fig 17. Basic Decoding.



Waveforms A and B, in fig 17, are from a two-stage binary counter which divides by 4.

Pulse C is required.

A and B are fed into an AND gate with Positive Coincidence

Fig 18

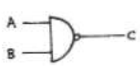
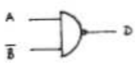


Fig 19



as in fig 18. and waveform C is the result, because A and B coincide positively only during the period C.

Fig 19. gives waveform D when A and $\overline{B}$ (i.e. inverted B) are fed into the AND-gate.

Obviously this principle can be extended to more than two inputs and the ÷7 ripple counter in fact needs 3 inputs to obtain pulses other than the output shown in fig 13. (that gate is still required as it is an integral part of the counter). For instance, to obtain the pulse in the ÷7 counter two pulses later on than shown would require $\overline{A}$, B and C.

As mentioned earlier, the shift-register type of counter needs only a two-input gate to decode any pulse no matter how large the count.

So for the 525 counter shown, the maximum number of inputs to a gate for a 1 to 524 pulse at 60 Hz would be 9 and the minimum would be 6, since the ÷3 and ÷7 contain one suitable pulse already.

The obvious way to make a 6,7,8 or 9 input AND gate is to use a ready made I.C., but the µL range has not got one. (Although the M.C. 700P series has). One can of course string many µL914's in series/parallel but a cheaper, and simpler, way is to use diodes and a resistor.

Fig 20

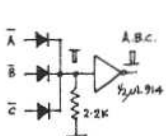
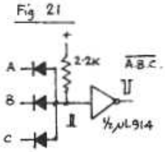


Fig 21



DIODES Germanium (CG 80H)

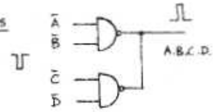
Fig 20 shows a 3-input gate for positive pulses. The invertor is present only to give good isolation and prevent power-loss.

It is in fact a NOR gate-if any one input is high, the diode conducts and the output is low. If all inputs are low, then the output is high. Note, the inputs A, B and C are chosen for Negative coincidence (i.e. all low).

Fig 21 shows the system for negative pulses. (the output is the same pulse). The diode polarities are different: note that Germanium diodes must be used as the forward voltage drop is low and the following invertor has to be able to turn off with the diode drop plus the counter bistable saturation voltage. This totals some 0.5V. Silicon diodes would raise this to 0.8V and the invertor would be permanently on. (in Fig 21). In Fig 20 only the 2.2K Ω resistor is not essential but is desirable to prevent leakage current effects due to temperature.

For 3 and 4 inputs, two µL914 outputs can be paralleled as in Fig 22. Only positive pulses are available from Negative-input Coincidence-i.e. all low.

Fig 22 Paralleling Gates



The dissipation in each gate collector load resistance is increased since twice as many transistors share it now. Hence the temperature rating is reduced. Not more than two gates should be paralleled in this manner.

Delay

A significant effect of gating several counter blocks together is the delay between the various pulses, due to the cascading.

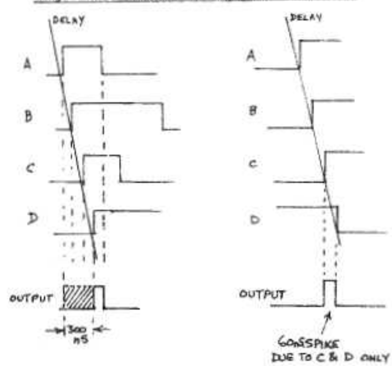
This can be reduced in one of two ways.

1. add more delay to the early counters

2. add extra gating to each block to obtain 1 unit wide pulses between blocks and also clock all bistables from a common source.

This latter method is very involved, and the former method is the one usually employed. But for Amateur T.V. (in a counter such as shown in fig 16., the total delay is only some 300 nS max.) can be ignored. Fig 23 shows the effect.

Fig. 23 Counter Delays (Exaggerated)



The gated result is narrower by 300 nS as only the leading edges are affected (in this example). This only becomes significant if the clocking speed is very high such that 1/f is approaching 300 nS.

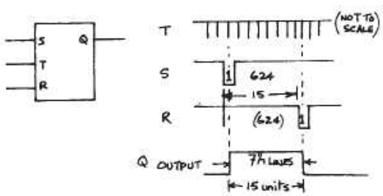
If pulses are changing in both directions at some other point in the waveforms (see fig 23) then a spike of up to 300 nS (but usually only 1 delay or 60 nS) may be present as well as the desired pulse. Whilst this can be removed by integration with a small capacitor after the gate, the edges of the required pulse are also slowed down.

For most applications this may not matter, but if the output is to feed a bistable T-input then integration sufficient to remove the spike will prevent the bistable from operating! If the spike is not removed the bistable will clock on it as well; giving an output change for no apparent reason! A 60 nS spike is practically invisible even on the best of Oscilloscopes!

Forming Pulses of known widths

For S.P.G. outputs the required pulses are multiples of the counter input frequency. e.g. on 625, Field Drive is 7½ lines or 15 input pulses.

Fig 24. Forming Field Drive (625)

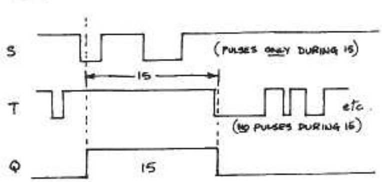


If we generate two pulses of 1 unit wide and 15 apart we can use these as discussed earlier to feed the S and R inputs of a bistable and also feed the bistable with the counter input pulses.

The result will be an output pulse of 15 units wide at the frequency of the 1 unit pulses and with the timing (and accuracy) of the counter input source This enables field-rate pulses to have line-rate stability which is a good feature of an S.P.G.

It is possible to make a saving here. If the leading-edge pulse (S) is at the required frequency- in this case 50 Hz- then the trailing edge pulse can be at any frequency provided that it does not occur until 15 units later. If it re-occurs later on, or lasts longer than one unit, it does not matter as the bistable has already been reset by the first T-pulse during this waveform and cannot be set again until the S-input goes low again. Thus the trailing edge pulse gate need not have so many inputs to it.

Fig 25 Simplified Gating



Furthermore even the leading-edge pulse can be of more than one pulse wide provided that it finishes within the 15. Hence further simplification is possible.

This process can be done at line frequency as well if the S.P.G. chain includes a suitable high frequency divider from, say, a crystal of 4 MHz.- which when divided by 128 gives twice-line frequency for 625! 128 being seven binary stages in cascade. 4 MHz gives a resolution of pulses to multiples of 250 nS. - 1MHz may be more suitable for Amateur work -giving 1 uS multiples - as 1MHz crystals are easily obtained.

Finally, by careful thought, Composite Syncs. can be made up entirely by such methods if the leading and trailing edges are separated and suitably gated themselves by other pulses.

This is rather complicated but perhaps such an S.P.G. could be the subject of article's in the future It is possible to make such an S.P.G. with no Resistors and Capacitors in the logic, and where no adjustments are necessary beyond the initial working out.

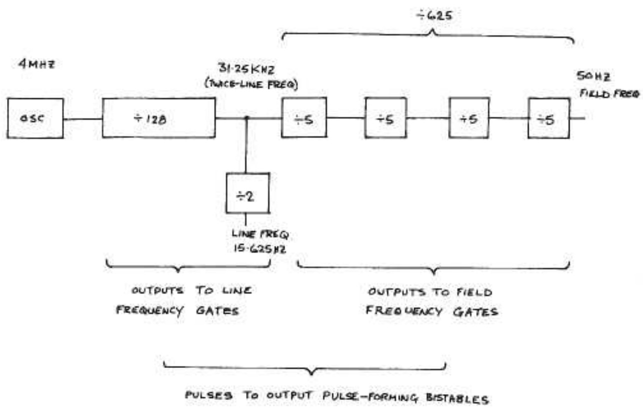
To conclude, therefore, this article has presented several bistable counters suitable for S.P.G. use and also the means of using R.T.L. Bistables to obtain pulses of width equal to any multiple of the input pulse interval.

The next article will describe a simple grille generator using principles outlined in these two articles.

Also, T.T.L. IC's will be investigated as these are considerably cheaper to buy (in the U.K.) and are generally faster and better in all respects than R.T.L. IC's which are now becoming obsolete-which is why they are available.

Further points concerning I.C. protection and external driving will also be discussed.

Fig 26 625 Counter Chain (Interlaced)



References

Motorola Application Notes

1. AN285 Loading factors and Paralleling rules for MRTL IC's.
2. AN254 using MRTL IC Flip-Flops
3. AN264 MRTL shift registers
4. AN234 MRTL family
5. AN252 choosing RTL

FAIRCHILD application Notes

1. AR132 Coherent counters
2. AR147 Monostable Multivibrators
3. AR157 T.V. Sync Generator (CCIR625)

Other References.

1. CQTV. No.70
2. CQTV. No.71
3. Practical Electronics July/Aug. 1970.

Errata in the last issue

1. Page 8
   "Two of the devices are shown in figs 1 and 3......"
2. Page 13
   "Supplies should be decoupled by means of a 47 nF......"
3. Page 13
   "...... and takes 3.4" of a 5¼" high, 19" G.P.O. rack".

The Author wishes to thank the Directors of E.M.I. Electronics for permission to publish these articles.

Letters to the Editor.

Dear Sir,

Re the article on the Mullard FET head amplifier, there appears to be an error in all the Mullard versions of the circuit in that R_{24} should be 68 ohms and not 680 ohms. This is the value given in the Philips version of the circuit (Overgoor, B., A Camera Tube Amplifier with FET Input, Electronic Applications, Vol. 28, No. 4, p. 155). There would seem to be no point in the 20 dB odd loss that 680 ohms would cause, and 68 ohms will give a match to the 75 ohms load quoted.

From my experience of this circuit, quite a lot of "tinkering" is necessary to get a flat response and a video sweeper is needed to make a decent job of it. I ended up with C_{10} replaced by a 2.7K resistor and 10pf from the emitter of TR_5 to the feed-back line. The latter increases the feedback at high frequencies which otherwise tends to get lost around R_{22} and R_{23}, resulting in a large hump in the response at 1MHz. However, it is no doubt, all a matter of layout.

David Wilkinson
New Eltham.

Dear Sir,

I was frankly amazed to see G6SOG/T's letter, which you printed in C Q - T V 71, advocating a 405 line standard for amateur television in this country. Is he trying to drag us back into the dark ages? Doesn't he realise that amateurs have always been in the forefront in television, were transmitting 625 before ITA and BBC, have a record undeniably enviable and could no more relinquish their lead than give up their hobby completely?

International links alone demand the use of 625, and as only receivers using that line standard are manufactured in this country, the use of 405 by amateurs would be to condemn ATV to a complete demise in a very few years. And since almost all the redundant broadcast equipment on the market is multi-standard, SOG/T's comment that buying this will reduce our costs is certainly no plea for 405.

So please, let us all continue to use 625 and forge ahead with more improvements to amateur television transmission - not drop back into the past.

"Modern Amateur"
London, N.W.

continued from p. 11

The square wave output from Tr5 collector is fed to the step generator. This consists of Tr8 and D1 used as a boot strapped diode pump.

During the positive-going edge of the square wave, charge from C7 is transferred through D1 to C8, resulting in a positive step across C8. During the negative-going edge, C7 is recharged from the emitter follower Tr8. As the base of Tr8 follows the step voltages across C8, the peak-to-peak voltages across C7 is the same for each step. This ensures that each step is of identical amplitude. At the end of each line, C8 is discharged by Tr16.

Tr11 and Tr12 form a Darlington-pair emitter follower, which has a high input impedance and causes negligible loading across C8. The "Step Output" impedance is about 3K ohm and is only suitable for feeding directly into a processing unit. If a 75 ohm output is required, a further emitter follower will be necessary.

The vertical bar generator consists of a pulse narrower circuit (See C Q - T V 68 page 10) driven from the vertical bar multivibrator.

The square wave output from Tr5 collector has a fast positive-going edge which turns off Tr15 for a period determined by the time-constant Tc1, R27.

This produces short positive pulses at Tr14 collector, which form the verical lines of the grille pattern.

The horizontal bar generator consists of a line counting circuit which, after a certain number of lines, changes the state of a bistable to the on condition for the period of one line, the signal resetting the bistable at the end of the line. A field drive pulse resets and immobilises the line counter, at the end of each field, to ensure that the horizontal lines are synchronised to field frequency.

The line counter consists of a constant current source, Tr3, which is only switched on during the line signal. Each pulse of current charges C3 in a staircase fashion until Tr7 conducts. Tr7 and Tr6 are cross-connected to form a regenerative switch which, when made conductive, effectively short circuits C3 through R28.

A positive-going output pulse from Tr6 collector is passed through C6 and D2 to turn off Tr9, thus setting the bistable formed by Tr9 and Tr10.

The negative change at Tr9 collector is inverted by Tr13 and forms the "horizontal line" signal. At the end of the line, a positive-going pulse from the junction of R5 and R6, through C9 and D3, resets the bistable and terminates the "horizontal line" signal.

Field drive is clipped and inverted by Tr2, to clamp Tr3 collector, at the end of each field, thus ensuring that counting will start at the same point in each field period.

RV1 sets the current to the line counter and thus determines the number of horizontal bars in each field. The combined output of Tr13 and Tr14 forms the grille output signal. The "Grille Output" has an output impedance of about 200 ohms and should be fed directly into a video processing unit.

Both the Step and Grille outputs are approximately 1V. p-p.

STOP PRESS We've just heard G6OPB/T Mike Bues of Epsom has succeeded in transmitting PAL colour bars to G6OUO/T Dave Mann of Wembley. More news next time.

ADVERTS.

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The above are available from the Club Sales Officer, whose address is printed on page 1.

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Contact Mike Bues G6OPB/T
61, Shawley Way,
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F/Lt. W.C. Brown GW8A1B
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c/o Hon Sec BATC.

Has anyone any old camera tubes of historical interest? Particularly 5527 Iconoscopes and early CPS Emitrons. If so, please contact John Tanner, c/o Hon. Sec., who is willing to exchange any early tubes for modern working ones.

HELP WANTED

The Club would be pleased to hear from members who would be willing to lend a hand with any of the Club's book-keeping or secretarial duties. Offers of assistance, which would be greatly appreciated, should be made to the Secretary at the address on page 1.

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