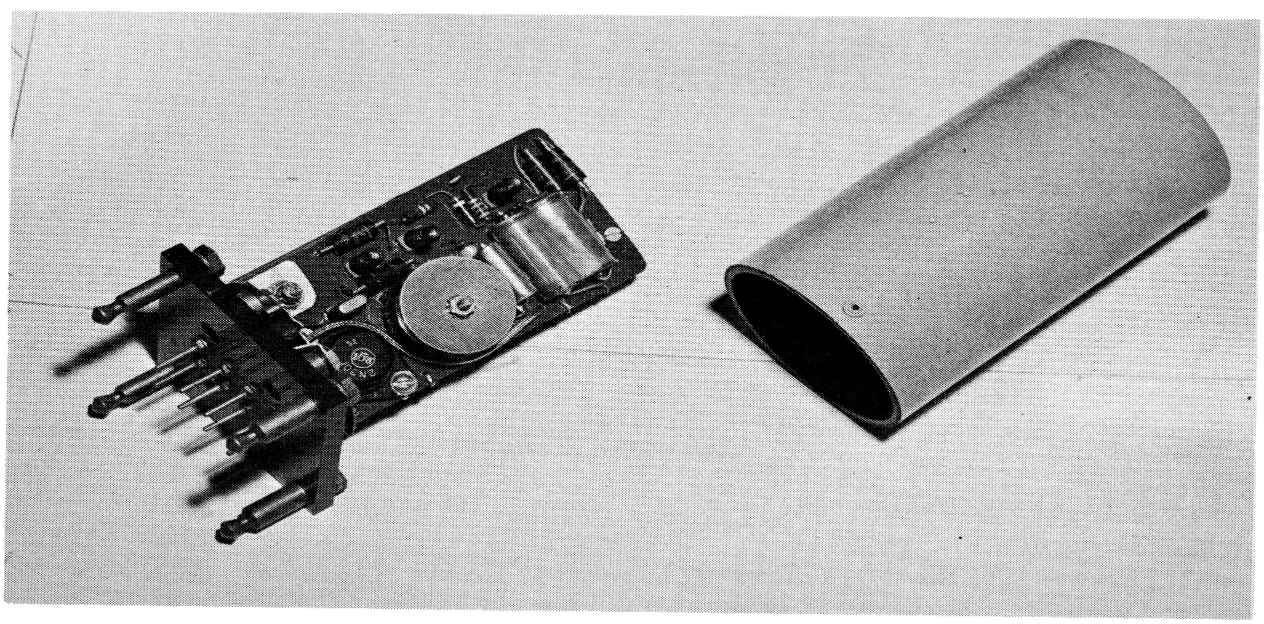
It was noted that in some particular versions constructed, neon lamp I_4 would not extinguish with no signal input. This might be cured by increasing the value of the plate resistor of V_{4a} to 1.5 megohms. This is because of variations in the characteristics of many 12AX7 tubes made for "entertainment" purposes. If at all possible, scrounge a military version or a "ruggedized" industrial equivalent, such as the type 5751. If you must use ordinary 12AX7 tubes, check some on a transconductance-type of tube checker for reasonably good balance of the two triodes.

Last but not least, it is almost essential to feed the receiver output to the converter through a band-pass input filter when operating on the QRM-full h.f. ham bands. (This is because limiters are such good harmonic generators.) It is a good idea, too, to insure the satisfactory operation of such a filter by isolating the input and output from the receiver and TU, respectively, with a fixed pad or attenuator with at least 3 db loss. See Chapter 7, Part 7.3b, for detailed information on an easily constructed band-pass input filter which may be used very effectively with this TU or any audio-type of TU having a 500 or 600 ohm input impedance.

c. Transistorized TU's

As the accompanying photo shows, it is possible to build a very practical workable transistorized radioteletype converter into a standard Western Electric 215A or 255A polar relay case. This was done by Phil Catona, W2JAV. According to Phil, this model was constructed as the result of exploratory thinking and it shouldn't be considered the last word in transistorized TU design. It does, however, open the way for thinking along the lines of simplified clock-controlled autostart or full time monitoring.



A miniaturized transistorized TU.

Construction

This little TU was constructed on a thin piece of bakelite fastened to the plug-in polar relay base and just big enough to fit inside the round relay cover. It contains everything required except the battery power supply, which is nothing more than a 7½ volt "C" battery. Sockets were used for all of the little transistors, but the 2N301 output power transistor was bolted directly to the bakelite "chassis." The 1½ volt diode limiter bias batteries were also mounted directly on the bakelite component board. The small toroid coils, used in the channel filters were also mounted on this board, one on each side, with bakelite washers and a single bolt was used to clamp them firmly to the board.

Circuitry

Figure 3.3c1 is the schematic diagram of this miniaturized TU. The input transformer, not visible in the photo, is a miniature 500 ohm to 20,000 ohm surplus job, but several small satisfactory substitutes are available in the *Argonne* line from Lafayette Radio in New York City. A pair of 1N69 diodes are connected back to back, with a pair of small 1½ volt cells as bias, to set the limiting level. The output of the diode limiter drives a 2N109 *pnp* transistor in a common-emitter circuit which provides a bit more limiting as well as some amplification. Another pair of 2N109's are used for phase splitting, and the collector circuit of each contains the tuned circuit, one for *mark* (2125 cycles) and the other for *space* (2975 cycles). The inductors are the usual 88 mhy telephone loading coil toroids, and the capacitor values are approximate. The reversing switch in this circuit was added later, as an operating convenience.

A miniature 100K ohm pot is connected across the load resistors of the diode detectors to permit compensation for the slightly different levels in the *mark* and *space* channels. The output of the detectors then keys the 2N146 *npn* transistor, which in turn operates the 2N301 as the on-off "switch" to directly operate the printer magnet of a Model 26 machine from the 7½ volt battery. Loop current on a steady *mark* should be about 50 to 60 ma, but don't let that disturb you. (The Model 26 selector magnets are

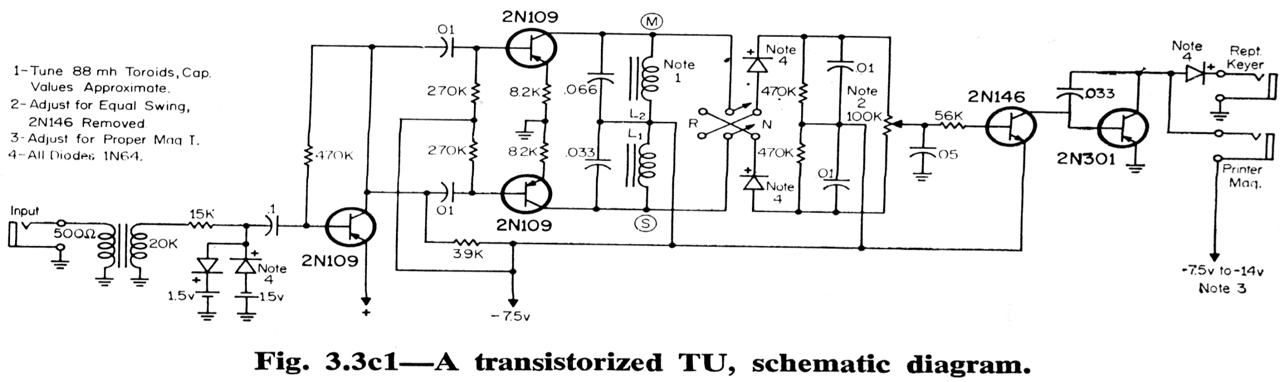


Fig. 3.3c1—A transistorized TU, schematic diagram.

connected in series.) This amount of current gives the best range, about 65 to 70 points, with the low voltage supply used.

The REPT. KEYER jack and the associated diode is a most ingenious device, and it is extremely useful, too. What it is simply, is another "switch," slaved to the 2N301. It can be used to key the f.s.k. circuit of a v.f.o. or an a.f.s.k. oscillator, to key the local loop in the shack. Of course, if no machine is plugged into the PRINTER MAG. jack, a dummy plug with a 180 ohm resistor connected across the contacts should be inserted in place of the machine selector magnets.

Adjustment

Tuning up the toroids and setting the detector balance potentiometer is easily done with a vacuum tube voltmeter and with the 2N146 transistor out of its socket. A tuning fork standard is very handy right here to make sure that you tune the toroids as closely as possible to the standard *mark* (2125 cycles) and *space* (2975). After tune-up, measurements should disclose a useful band-pass of about 300 cycles for each filter, and limiting should begin at an audio level of about –39 dbm. A convenient operating level is about "0 db" or about plus 8 dbm on the 500/600 ohm line from the receiver. If your receiver has a high level output, it is a good idea to connect some sort of attenuator in the line to permit operating this TU at the recommended input level.

The Polar Circuit

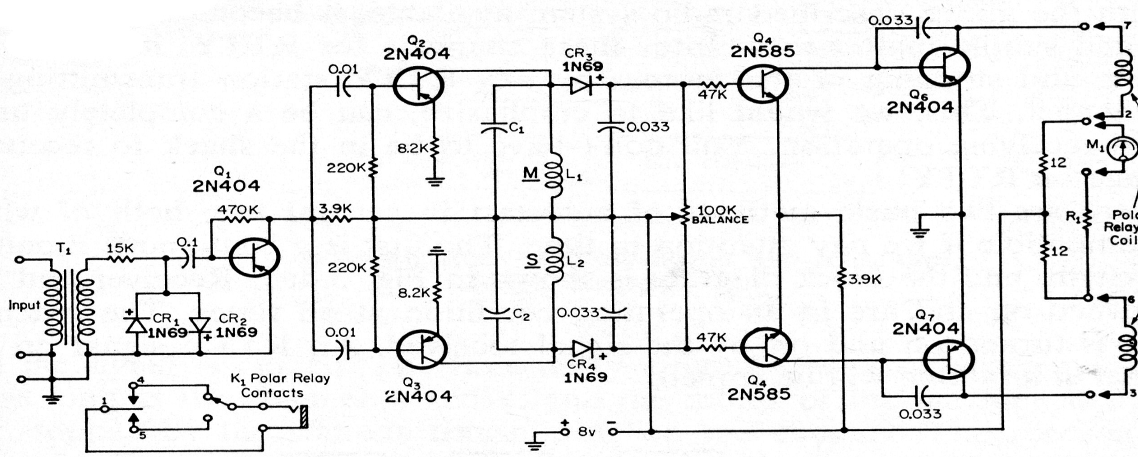
Figure 3.3c2 is the schematic diagram of the latest version of the transistorized polar RTTY converter as revised by W2JAV. If you will examine this diagram and compare it with that of the neutral circuit, Fig. 3.3c1, you will see that the limiter and detector circuitry are identical. The difference is after the detector. The *mark* and *space* channels remain separate, and two type 2N585 *npn* transistors are directly coupled to separate 2N404 *pnp* transistors with the polar relay connected in the collector circuit of each. Note that no power transistors are required to operate the polar relay.

The obvious advantage of this circuit is that the inherent and excellent low-pass filter action of the polar relay is utilized, and the "floating" or isolated contacts of the polar relay permit a large degree of flexibility when it comes to designing your own local loop system.

Performance

The not-so-obvious advantages came to light when this polar TU was tested. First of all, a full 80-point machine range was realized. The TU also proved to be a bit more sensitive; and, although each side of the polar relay was hit with up to a 40 ma pulse, depending upon power supply, under actual keying conditions, less than *2 ma* was drawn by the entire TU in the complete absence of audio input!

The extremely low drain of the transistorized polar TU makes it quite



Parts List

C1—0.066 mf, 100 v., Sprague Vitamin-Q. Vary if necessary to tune L1 to 2125 cycles.
C2—0.033 mf, 100 v., Sprague Vitamin-Q. Vary if necessary to tune L2 to 2975 cycles.
CR1, CR2, CR3, CR4—1N69, Clevite.
K1—255A polar relay, WE; socket WE 18B.
L1, L2—88 mhy toroid telephone loading coil.
M1—1-0-1 ma meter, surplus IS-180 or similar.
Q1, Q2, Q3, Q6, Q7—2N404, RCA *pnp* transistor.
Q4, Q5—2N585, Sylvania *npn* transistor.
R1—1000 ohms; vary to get desired reading on M1.
T1—600 ohm primary, 19,000 ohm secondary; surplus FTR GH-1202-2, Barry Electronics, New York City.

Fig. 3.3c2—A transistorized polar converter.

feasible to use an ordinary dry battery as the power supply, and makes it very practical to go into full time monitoring of an a.f.s.k. autostart channel. (We will leave the design of the transistorized v.h.f. receiver to you.)

3.4 Autostart

a. Autostart Methods

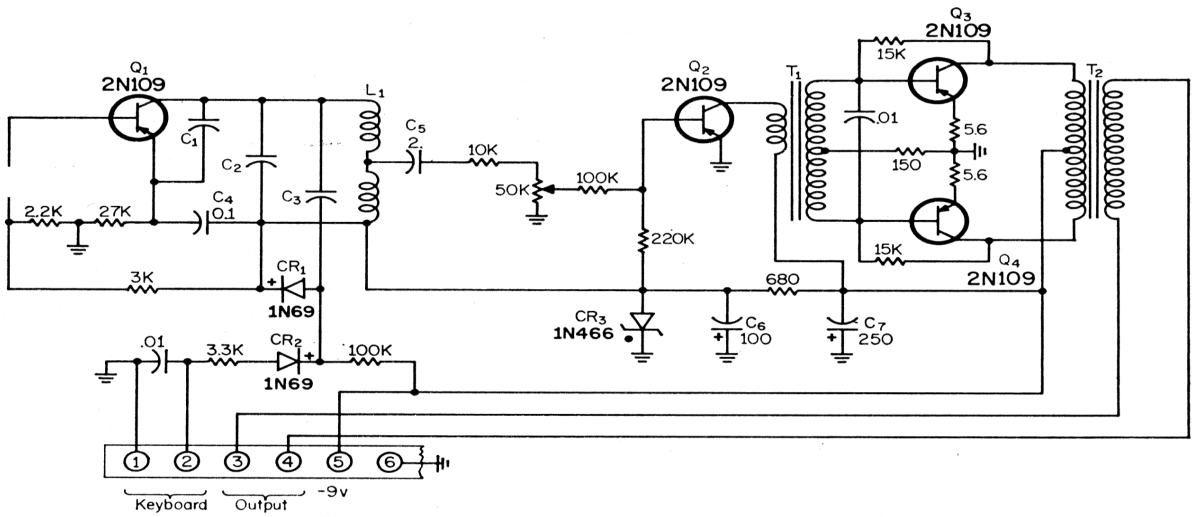
Autostart is one of the most fascinating aspects of amateur radioteletype. It is used on v.h.f., usually in metropolitan areas and their populous suburbs, and a.f.s.k. is the mode. Instead of the more common random-frequency operating, RTTY nets stick to one net frequency, mostly on the high ends of the bands where they won't bother the dx-chasers, and where *they* won't be bothered by QRM. This practice, of course, makes it very convenient to use crystal-controlled receivers as well as transmitters. Early RTTY nets on v.h.f. used the war surplus SCR-522 a.m. sets. Modern nets are now using commercial surplus police-type f.m. sets, with tremendously extended range as compared to the old a.m. sets. The "squelch" feature of these sets makes possible the completely noiseless monitoring of a channel as their audio amplifiers are completely cut off in the absence of a carrier.

The A.F.S.K. Oscillator Circuit

Figure 4.1b1 shows the schematic diagram of the a.f.s.k. oscillator and its amplifier. The basic circuit of the oscillator is that developed by W2JAV and was shown in the RTTY column of *CQ* for February 1958. In the interest of stability, circuit changes recommended by W2JAV were made. One of these is the addition of the 1N466 Zener diode, CR_3, used as a voltage regulator to supply the 3.5 volts for the collector. Phil also recommended that the higher gain type 2N404 transistors be used. (We used the RCA type 2N109 extensively because that was what was in the junk box.)

The inductor L_1 is the ubiquitous "88 mhy" toroid telephone loading coil. Its windings are connected series-aiding for maximum inductance by connecting together two adjacent wires, one on each side of the plastic barrier separating the two coils. Output from the oscillator itself is then taken from this junction of the two coils. With the keyboard contact circuit open, the *space* frequency, which should be 2975 cycles, is determined by the 0.033 mf capacitor C_1 connected between the collector and emitter of Q_1 (and to some extent by C_4) and the 0.008 mf capacitor C_2 across L_1. With the keyboard circuit closed, the *mark* frequency, which should be 2125 cycles, is determined by the addition of the 0.033 mf capacitor C_3 (connected by the diode switch) to the capacitors already in the circuit for the *space* frequency. The Zener diode CR_3 is connected with the reference dot towards ground, which is the plus side of the d.c. supply.

The a.f.sk. oscillator frequencies should be adjusted with reference to some standard of known accuracy. If you have an ordinary variable frequency audio oscillator, check it against some fellow RTTYer's fork standard or with some a.f.s.k. on the air. With a pair of headphones connected across the audio output terminals, feed in the reference oscillator at the top of the



Parts

C1, C3—0.033 mf, 100 v., Sprague Vitamin-Q
C2—0.008 mf, 600 v., Sprague 6EP-D80
C4—0.1 mf, 100 v., Sprague Vitamin-Q
C5—2 mf, 6 v., Sprague TE-1081
C6—100 mf, 6 v., Sprague TVA-1101
C7—250 mf, 12 v., Sprague TVA-1131
CR1, CR2—1N69, Clevite
CR3—1N466, 3.5 v. Zener, Hoffman
L1—88 mhy toroid telephone loading coil
Q1, Q2, Q3, Q4—2N109, RCA
T1—AR-109 driver, Argonne
T2—AR-162 output, Argonne, etc. (see text)

Fig. 4.1b1—Transistorized a.f.s.k. oscillator.

GAIN control (through a blocking capacitor). With the keyboard circuit open and the reference oscillator set at 2975 cycles, you will be able to hear both oscillators in the headphones. You should be able to zero-in the a.f.s.k. oscillator by removing turns from the inductor L_1. Once the *space* frequency is set, close the keyboard circuit and check the frequency with the reference oscillator set at 2125 cycles. You should be very close. If you are not within 10 or 20 cycles, you can set it right on the nose by varying the "0.033" capacitance (C_3) in the diode switch circuit by simply trying other capacitors marked the same, or if you are way off (high), add capacitors of about 0.0005 mf or so until you make it. Once set up this way the oscillator should stay within a few cycles for years. Just make sure you use a good grade capacitors, mylar preferably, or a good paper type. *Do not use ceramic or disc capacitors.*

Transistor Q_2 is a voltage amplifier and is the driver for the Class B output stage. The driver transformer T_1 has a 10,000 ohm primary and a 2,000 ohm center-tapped secondary. The output transformer T_2 is a 500/600 ohm line-to-line transformer. The primary must be center-tapped, such as the Argonne AR-162.

The Speech Amplifier Circuit

Figure 4.1b2 is the schematic diagram of the speech amplifier. The input is designed to work from a high impedance microphone. (We use the dynamic Turner U9S.) The first stage uses a GE 2N191 connected as an emitter-