THIS MANUAL APPLIES TO AMT-2

SOFTWARE REVISIONS FROM 1.3

ONWARDS

FOREWARD

The AMT-2 is a sophisticated microprocessor controlled terminal unit, offering considerable versatility combined with ease of use.

If you have bought one of the many software applications packages for the AMT-2, you will be almost entirely insulated from the ESCAPE and CONTROL code sequences which are dealt with at length in this manual. You will need to go through the initial sections of the manual, covering connection details and initial set up. From there on, refer to the manual of your software driver package. Unless you have any problems, you should not need to refer to the remainder of the AMT-2 manual.

With care in installation and proper attention to the shielding and grounding of leads, the AMT-2 should provide many years of reliable service. We keep a register of the modifications which are needed for a small minority of older generation transceivers to provide switching times which are fast enough for AMTOR. Call us if we can help in this respect.

Probably the most important mode implemented on the AMT-2 is AMTOR, a, by now, widely used error correcting RTTY system. The microprocessor software in the AMT-2 was written by G3PLX, the "father" of AMTOR. It represents the latest and most definitive implementation of that mode.

WARNING

Do not run your transmitter at full power in AMTOR FEC, ASCII or RTTY modes unless you know that it is rated for 100 per cent duty cycle operation. For most SSB transceivers, it is safe to adjust the power output to half the maximum level.

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SPECIFICATION

POWER SUPPLY:-	11 - 13.5 Volts at 350 mA
MODES OF OPERATION:-	
Morse Code	1 - 100 w.p.m.
RTTY (CCITT No. 2)	1 - 100 Bauds
ASCII (CCITT No. 5)	110 Bauds
AMTOR (CCIR 476)	FEC mode
	ARQ mode
	ARQ/FEC combined standby mode
	ARQ listen
TRANSCEIVER INTERFACE:-	
INPUT	
Sensitivity	20mV RMS
Bandwidth	300 Hz. 4 pole filter (switchable to wide bandwidth)
Tone Frequencies	1275/ 1445 Hz, switchable polarity (2125/2296 Hz, High tones version)
OUTPUT	
Level	0 - 500 mV RMS
Tone Frequencies	1275/ 1445 Hz (optional polarity) (2125/2296 Hz, High tones version)
PTT	Ground to transmit (100mA max.) Open to receive (30v max.)
FSK	Optional polarity. (100mA; 30v max.)
TERMINAL INTERFACE:-	
Voltage Levels	RS-232
Data Rate	300 Bauds (1200 selectable)
Data Format	1 start bit, 7 data bits. Parity bit:- Send 0, Receive, ignore. Stop bits - Send,1; Receive 1 0r 2.
INTERNAL BUFFERS:-	1800 characters, transmit. 80 characters, receive.
DIMENSIONS:-	241.3 x 160.78 x 35.05 mm
WEIGHT:-	Approx. 600 gms.
TEMPERATURE RANGE:-	10 - 35 degrees Centigrade

1) INTRODUCTION

The AMT-2 connects between a radio transceiver and a computer or computer terminal. It converts text entered from the terminal into encoded audio tone signals which are transmitted over a radio link. It also decodes audio signals from the radio into text to be passed to a terminal.

All four popular radio telegraph systems are catered for in the AMT-2:- Morse code; CCITT No. 2 (RTTY); CCITT No. 5 (ASCII) and CCIR Recommendation 476 (AMTOR). The latter three systems employ FSK (frequency shift) keying.

All four modes are used extensively on the amateur bands, each having its own special advantages. Morse (CW) can be used by almost any station, and is therefore the most universal. RTTY is the next most popular mode, with many stations using cheaply available surplus TELEX equipment. AMTOR is increasing rapidly in popularity, since it is by far the most effective mode under poor conditions. ASCII (although not as good a communication mode as RTTY) has the advantage of a larger character set, and is popular among computer users for local working and the interchange of programs.

2) INSTALLATION

The AMT-2 has three external connections:-

An 11 - 13.5 volt supply, at a current of 350 mA, is required at SK1 with the positive terminal connected to the centre pin and the negative connected to the outer. This is also connected internally to the chassis or common line of the other two sockets. The AMT-2 is protected against reverse or excessive voltage, but such voltages will probably blow the internal fuse.

The AMT-2 transceiver connection is via SK3. Audio from the loudspeaker extension socket or auxiliary audio output should be connected to pin 1. Audio from the AMT-2 for transmission is available on pin 3, and should be connected to the transceiver MIKE input or to an auxiliary audio input. FSK keying is available on pin 4 for those transceivers which have a direct FSK facility. Transmit/ receive switching occurs pin 5, which connects to the PTT line of the transceiver. The common return for all these connections is on pin 2. It is recommended that screened cable be used for all connections, with the screens returned to pin 2. These connections are summarised in table 1 which also has space for you to enter the corresponding connections to your transceiver.

TABLE 1 - Transceiver pin connections:-

AMT-2 pin	SIGNAL	Transceiver Connection	Pin
1	Audio in	Extension Speaker	
2	Common	Common	
3	Audio out	Microphone	
4	FSK out	FSK in	
5	PTT	PTT in	
6	spare		
7	spare		

Connection to the computer or terminal is via SK2. Data from the AMT-2 to the terminal is on pin 3 and data from the terminal to the AMT-2 enters on pin 1. The common return is on pin 2. Again, screened leads are recommended for these connections. At the computer terminal end of this cable, connection should be made to the "RS232" or "SERIAL port, with "transmit data" connected to "data in", and "received data" connected to "data out". Any RTS, CTS, DCD, DTR, or DSR connections on the computer should be left open or connected as described in the computer handbook so as to allow data to flow at all times.These connections are summarised in Table 2.

TABLE 2 - Terminal Pin Connections:-

AMT-2 Pin	SIGNAL	Terminal Connection	Pin
1	Data In	Transmit Data	
2	Common	Common	
3	Data Out	Receive Data	
4	spare		
5	spare		

Although the user may wish to use a personal computer as the terminal for the AMT-2, the basic requirements are met with a simple terminal, or by running a terminal emulation program on the computer. A key pressed on the keyboard results in the corresponding ASCII code being transmitted to the AMT-2. Reception of an ASCII code from the AMT-2 results in the corresponding character appearing on the terminal display. This mode of operation is often referred to as a DUMB TERMINAL mode. The DUMB TERMINAL mode is also used when the computer accesses a larger computer via a telephone line. In what follows it is asumed that a dumb terminal mode is being used. Reference will be made to keys by their ASCII names, such as ESCAPE, and CONTROL A. On some computers, such keys may not exist, in which case reference should be made to the documentation provided with the computer or terminal program. If writing your own program in Basic, you can create these codes with a CHR$ command. [ESC is CHR$(27)].

3) SET UP

After connecting the three cables, there are some adjustments to be made to match the characteristics of the AMT-2 to your transceiver and terminal. These are:-

A) Terminal speed.

Decide whether the terminal will operate at a data rate of 300 or 1200 Bauds. Cut LK1 to operate at 1200 Bauds. Leave it in place for 300 Bauds.

B) FSK Polarity

In AMTOR, RTTY and ASCII modes, the polarity of keying of the audio tones, both received and transmitted, must orrect. The choice of polarity has been agreed worldwide, so that once set correctly, no change is needed between contacts. However, the means of achieving the correct polarity may differ from one transmitter to another.
On European AMT-2 models, it is assumed that the user will always have his SSB transceiver in UPPER sideband (even on 3.5 and 7 Mhz). If this is the case, then LK3 should be installed. On USA models, it is assumed that the user will use LOWER sideband. In this case LK3 should be open. The transmitter polarity will then be correct.
If the opposite sideband must be used for any reason, then LK3 should be changed from the factory-set condition, and the front panel NOR/REV switch should be left in the "REV" position (or physically reversed behind the panel). If the FSK output is used, then establish by experiment which position of LK3, and which position of the NOR/REV switch gives the correct polarity. This will depend on the transceiver used.

[At this point, the AMT-2 may be connected to the terminal and power applied. The CMD led will light and the AMT-2 will send RETURN and LINEFEED codes to the terminal].

C) Receive Audio Level

Key Z0 on the terminal keyboard. The tuning display will light, and either or both of the ERROR and RQ LEDs will light. The SEND LED may also light.

Adjust VR3 in the AMT-2 until, with the receiver audio gain set at the normal listening level, received signals cause the SEND LED to light. Background noise alone should not light the SEND LED. This sets the amplitude of the audio from the receiver to the AMT-2 demodulator. The setting is not critical, but will allow the receiver audio gain control to be set at the most comfortable level for listening.

CW and FSK signals may now be tuned in on the receiver. Some practice can be made at tuning CW signals to the centre of the tuning display. FSK signals should be tuned such that the two tones are displayed equally spaced either side of the centre.

When correctly tuned in, an FSK signal will cause the ERROR and RQ LEDs to flash in sympathy with the left-right oscillation of the tuning display. A correctly tuned CW signal will result in a central display. The receiver audio gain control should be adjusted so that the SEND LED flashes in sympathy with any keying of the received signal.

D) Transmit audio level

Key ESCAPE on the terminal and prepare the transceiver to transmit into a dummy load with the MIKE gain and drive controls at the positions you would normally have them for SSB operation.

Key Z3 on the terminal. The AMT-2 will turn the transmitter on and radiate a continuous tone. Adjust VR5 such that the transmitter output just reaches the level at which it is rated for continuous operation.

Take care not to overdrive the transmitter! Apart from probable overheating if it is overdriven for long periods, too much audio will cause spurious signals to be radiated on either side of your intended signal. At the end of this operation, key ESCAPE to turn the transmitter off.

E) PTT delay.

In all transceivers, there is a short delay between keying the PTT line and the emergence of full power from the antenna. In RTTY and ASCII modes, this short delay is of no consequence, but in CW and AMTOR modes, some allowance may have to be made.

The AMT-2 has an internal adjustment, VR4, to ensure that it does not send signals to the transceiver before it has fully changed to transmit. To set this adjustment accurately requires the use of an oscilloscope but a simpler, less accurate, method will often suffice.

Prepare the transceiver to transmit - preferably into a dummy load; turn VR4 fully clockwise and key Z7. The transmitter will key rapidly on off. Whilst watching the PA current meter on the transceiver, turn VR4 slowly anti-clockwise and note that although the PA meter is oscillating, the average reading rises. Stop rotating VR4 at the point where the meter stops rising, then back it off slightly. At this point, the AMT-2 is just starting to send the audio tone to transceiver at the point when it is capable of radiating full power. Note that for this simple method to work, the PA meter must register the average rather than the peak current. It will not work if the meter is of the "peak-reading" P.E.P. type.

Generally, if such a P.E.P. meter is used in the power meter position, the PA current meter is usually an average-reading meter, so this method will usually give a sufficiently accurate result. A full description of the use of an oscilloscope for this adjustment is given in the Alignment section of the handbook. If neither method of adjustment is possible, leave VR4 in the fully clockwise position, which will allow operation in all modes except fast CW and long-distance AMTOR ARQ.

4) OPERATION

A) General

At all times, entering an ESCAPE code from the terminal will bring the AMT-2 out of the current mode and into the COMMAND mode. The CMD LED will light and the next letter entered from the terminal determines the command. Valid letters are A B C D F I L N Q R S T X and Z. The Z or TEST mode has already been introduced in the SET UP section, and will be further described in the ALIGNMENT section. The other modes will be described later. Entering an invalid COMMAND letter will cause the AMT-2 to display a ? on the terminal. It will then wait for another letter to be entered.

Some of the COMMANDS set up parameters in the AMT-2. Others enable or disable some of the facilities. The first ofse to note is the LOCAL ON/OFF facility. If, during the preceding set up, each character entered from the terminal has appeared twice on the display, then you have probably configured it to display every character entered on the keyboard. The AMT-2 is also configured to do this, and for good reasons. If both units do this, then each character entered will appear twice. If possible, the terminal should be reconfigured so as not to echo keyboard text , but if this is not possible, then the echo in the AMT-2 will have to be disabled. This can be achieved by entering ESCAPE followed by L followed by 0. The LOCAL facility can be turned on again by keying ESCAPE followed by L followed by 1.

Another basic facility is AUTO NEWLINE. To save the user having to remember when to send a CARRIAGE RETURN and LINEFEED character pair at the end of a line, the AMT-2 can do this automatically. It sends the CRLF sequence so as not to split the last word of the line. If this facility is not required, then the NEWLINE feature can be turned off by entering ESCAPE N0 and on by entering N1. The LOCAL and NEWLINE features operate in all modes.

Other parameters which relate to individual modes will now be described.

B) RTTY MODE

To switch to RTTY, enter ESCAPE then R. The RTTY LED will light and signals may then be tuned in on the receiver. A correctly tuned signal of sufficient strength will cause the tuning display to light. The signal should be tuned such that two dots appear symmetrically on each side of the centre of the display. Whilst the distant station is sending traffic, the TFC and IDLE LEDs will alternate. When the distant station stops sending, the tuning display will consist of a single dot on one side, and the IDLE LED will be illuminated.

The ERROR LED will light if the incoming signal stop is not of the expected polarity. This will occur if the signal fades; is subject to interference; if the signal in question is not RTTY at all; if it is at a different Baud rate, or it is of the wrong keying polarity.

The RTTY Baud rate of the AMT-2 defaults to 45 Bauds at switch-on, but can be changed to any speed in the range 01 to 100 Bauds by entering ESCAPE B followed by the desired rate. This is entered as a two digit number. Common speeds in use are 45, 50, 75, and 100 Bauds (100 is entered as 00). Another possible cause of erroneous copy is that the received signal is keying in the wrong polarity. Whilst there is a well known convention concerning the keying polarity, reversed signals are sometimes encountered. Switching the NOR/REV switch to the REV position will enable such signals to be copied.

Some non-amateur RTTY transmissions use a wider frequency shift than the 170Hz standard. To copy such signals on the AMT-2, switch the WIDE/NARROW switch to the WIDE position. The transmitted signal is not affected by this switch. The WIDE/NARROW switch should be left in the NARROW position, and the NOR/REV switch should be left in the NOR position for amateur two-way contacts on all modes.

To transmit on RTTY, key CONTROL C on the keyboard. On most keyboards this is done by pressing the CONTROL key whilst simultaneously pressing the C key. The AMT-2 will turn the transmitter on, and the SEND LED will illuminate. Text can then be entered from the terminal and will be transmitted. The TFC LED will light when this is occurring. If text is entered whilst receiving, it will be stored in an internal buffer to be transmitted when the transmit changeover is made. The IDLE LED will light when the store is empty.

To change to receive, key CONTROL D, but that if the TFC LED is on at that time, the AMT-2 will remain in transmit until all stored traffic has been sent.

If received text changes spuriously from letters to garbled figures due to a missing "letters" code or a spuriously received "figures" code, correct copy can be restored by pressing DEL (sometimes called RUBOUT).

Should you wish to monitor a specific channel for RTTY signals, adjust the audio gain of the receiver until, with no signal, the tuning display is always off. This will prevent the AMT-2 attempting to decode background noise which would eventually fill the display with rubbish.

CW MODE

To enter the CW mode, key ESCAPE C. The CW mode LED will light and CW signals may then be tuned in. Tune the receiver so that the signal is in the centre of the display. Adjust the audio gain to the point where only the desired signal causes the tuning display to light and background noise, which gives a broad band of light on the display, does not show.

The AMT-2 will then display received text on the terminal provided that its CW speed setting is roughly the same as that of the signal being received. On switch on, the AMT-2 defaults to 20 words per minute. This can later be set to any speed in the range 1 to 100 wpm by keying ESCAPE followed by S followed by the desired speed in wpm. This is entered as a two digit number (100 is entered as 00). Alternatively, if the speed of the received signal is not known, then, whilst receiving CW, key CONTROL C. This increases the received speed by 1 wpm each time it is pressed. CONTROL D decreases speed by the same amount.

A little practice will enable the user to judge which way to adjust the speed to obtain best copy. If the copy contains too many spaces between letters, then key CONTROL D to reduce speed. Conversely, if spaces are missing between words, then key CONTROL C to increase speed.

To transmit CW, simply type on the keyboard, and the text will be sent at the same speed as is currently being received. If the received signal is present when a key is pressed, the AMT-2 will wait until there is a pause in the incoming message before breaking in. As with RTTY, the transmitted text will be echoed to the terminal as it is sent out. There may therefore be some delay if your typing is faster that the sending speed.

Remember to use the space bar between words. Depending on the setting of the delay preset in the AMT-2, there will be some distortion of the keying if the selected speed is too high for the delay in use. For example, if the VR4 setting is midway, do not use sending speeds faster than 50 wpm.

If the NEWLINE facility is on, then both received and transmitted text will be formatted into lines so as not to break words. There is no CARRIAGE RETURN or LINEFEED character in Morse code, and so the NEWLINE feature has no effect on the outgoing message, only on the local terminal display.

D) ASCII MODE

Key ESCAPE D to enter the ASCII mode. The ASCII mode LED will then light. The operation of ASCII is almost identical to that of RTTY, with the tuning display operating in the same manner. CONTROL C is used to change to transmit, and CONTROL D is used to change to receive.

The differences are that only one Baud rate is available (110 Bauds) and that the character set is much larger, with both upper and lower case letters being available, as well as a wider variety of punctuation marks and signs. There are no equivalents to the "letters" and "figures" codes of RTTY and AMTOR, so the DEL key has no effect in ASCII mode. The receive side allows only CARRIAGE RETURN and LINEFEED control codes to be passed to the terminal. Only these controls will be passed to the radio if entered from the keyboard.

E) AMTOR MODE

Key ESCAPE A to enter AMTOR mode. The ARQ LED will light, together with the STBY LED, indicating that the AMT-2 is waiting for a call.

The tuning display will be permanently on, and SEND LED will light if there is a sufficiently strong signal from the receiver. In this condition, nothing will be displayed on the terminal until either an FEC or an ARQ selcal signal is received.

If an FEC signal is received, then the FEC mode led will light and the STBY LED will be replaced by the IDLE LED. The TFC LED will then light when the distant station starts to send traffic, which will be displayed on the terminal. The FEC system can correct many of the errors that might arise due to fading or interference, but in the event that an uncorrectable error is encountered, the affected character is not sent to the terminal. The ERROR led is lit instead.

When the FEC signal ends, the AMT-2 will return to STBY. It will also do this if the signal becomes too difficult to copy over a period of several seconds.

While the AMT-2 is in STANDBY mode, an FEC transmission may be made by keying CONTROL B. The transmitter will be turned on, and the SEND LED will light. The outgoing message can then be typed. The TFC LED will light while the message is being sent and the IDLE LED will be on when the buffer store is empty.

End the FEC transmission by keying CONTROL D. This sends a special "close-down" signal to put the distant receiving stations back to STBY. For this reason, it is important not to end an FEC transmission by entering ESCAPE, as the distant stations will print garble for a few seconds before reverting to STBY.

As well as responding to a received FEC call, the AMT-2 will respond to an ARQ selective call - provided that the selcal code received matches that of the IDENT code set into the AMT-2. On switch on, no such code is set, so the AMT-2 will never respond. To set an IDENT, key ESCAPE I, followed by the desired 4 letter code group. It is normal to choose a 4 letter group made up of the first letter and the last three letters of the station's callsign. Thus if your callsign is G3PLX, enter ESCAPE I followed by GPLX.

When another .station calls with your selcal, the AMT-2 will respond by transmitting in bursts in reply to the bursts of the ARQ calling signal. The tuning display will change from continuous mode to a "strobe" mode, in which it brightens up only when decoding the incoming signal.

The STBY LED will be replaced by the RQ LED until the distant caller copies the reply. Then the TFC or IDLE LEDs will come on to signify that the contact has been established and that traffic can be passed in either direction.

An ARQ contact can be initiated from either station. To initiate a contact, then, with the AMT-2 in AMTOR STBY, key CONTROL A, then enter the 4 letter selcal code of the station you wish to call. The AMT-2 will begin to key the transmitter in bursts, calling the other station, and the PHASE and SEND LEDs will light. If there is no reply. the AMT-2 will revert to STBY after a timout period (see later). If the distant station replies, the tuning display will change to the "strobe" mode, and the PHASE LED will be replaced by the TFC or IDLE LEDs to signify that contact has been established.

Whichever way the ARQ contact began, the stationse SEND LED is on can type to the.other. The station which started the contact sends first. He may then pass the transmission to the other station by entering "+?". Alternatively, the receiving station can initiate the changeover by keying CONTROL C. In either case, the OVER LED will light while the link changes round. The TFC and IDLE LEDs indicate whether the link is sending traffic or if the buffer store at the sending station is empty.

To end a contact, the last station sending should key CONTROL D. After sending any remaining stored text, the OVER LED will illuminate briefly whilst the link is closed down and both stations revert to STBY. Again, it is important not to try to end an ARQ contact with ESCAPE. This will probably result in the distant station attempting to re-establish the contact automatically, as described next.

If propagation between the two stations is poor, the contact may be slowed down by repeat sequences. These are indicated either by the ERROR LED if the locally received signal is the cause of the holdup, or by the RQ LED if the distant receiver is in trouble. In either case, no erroneous text appears, but a pause will occur in the traffic flow at both ends of the link. If repeats occur for 15 secs continuously, both stations will revert to PHASE.

In this condition, the station that initiated the contact will attempt to restart it. The other station will appear to be dormant until it responds to the call. If the PHASE operation is successful, then the contact will continue as before with an automatic changeover if required to reinstate the original sending direction. No traffic will be lost in a PHASE operation, and neither station need make any intervention or stop entering text. However, it is an advantage to be able to recognise a PHASE operation when it happens so as not to conclude by mistake that there is a fault in the system.

If the PHASE operation fails to regain the link within a certain time then the contact, and any traffic still in the two stations's buffers, will be lost. The PHASE timeout is set to 30 secs at switch on, but can be reset to any value between 01 and 99 secs by entering ESCAPE T followed by the desired time in seconds (entered as a two-digit number). This timout figure also applies to the initial ARQ call. It is therefore advisable to set it to the desired value before making an ARQ call, as there is no way to abort an unanswered call, other than with the ESCAPE key.

As in RTTY, text may be entered in advance whilst receiving; in STBY, or whilst waiting for an outgoing ARQ call to be answered. CONTROL C and CONTROL D can be entered whilst in STBY or while waiting for an ARQ call reply. They will then act as described if and when a contact is established. The DEL key operates as in RTTY to correct spurious figure-shift copy.

Sometimes, whilst monitoring a busyling channel, it may not be desirable to copy all the FEC messages that appear. The FEC receive mode can be disabled by entering ESCAPE F0 and enabled by F1. The FEC mode is enabled on switch on.

Note that if the ESCAPE I command has not been used since switch on, then the AMT-2 will not respond to any ARQ signal. If this is the case and FEC is off, the unit will not respond to any signal at all. It will only be capable of originating calls.

ARQ listen

There is one additonal mode available within AMTOR. Keying CONTROL F whilst in STBY enables the AMT-2 to copy ARQ signals without actually entering into a contact. This is known as ARQ LISTEN.

To do this, key CONTROL F and the PHASE LED will light. Tune in an ARQ transmit signal (long bursts). The AMT-2 should synchronise to the signal, as indicated by the tuning display changing from the continuous to the "strobe" mode. The traffic being sent will appear on the terminal display. If the signal being monitored is sending an ARQ selcal, it will be printed out repeatedly and the RQ LED will be on continuously. The RQ LED will come on also if the station being monitored requests repeats from the station he is in contact with. The error led will be on if the signal itself is mutilated. Otherwise, the TFC or IDLE LEDS will be lit.

When the station being monitored passes the transmission over to the other station, the AMT-2 will drop out of synchronisation and wait to try to synchronise with the other station. At any time, CONTROL F can be entered to make a fresh attempt to synchronise. This may be necessary at times, as the LISTEN mode can sometimes get into a false lock with an idling signal. To leave LISTEN mode, enter CONTROL D to return to AMTOR STBY.

5) ESCAPE COMMANDS

Here is a fuist of the AMT-2's ESCAPE commands with a brief description of what they do:-

A: AMTOR mode. Before entering AMTOR mode, ensure that the IDENT, TIMOUT, and FEC parameters have been set to the required values.

B: BAUD set. Enter the RTTY Baud rate as a 2 digit number between 00 and 99.

C: CW mode. Ensure that the SPEED parameter has been first set as required.

D: ASCII mode. 110 Bauds only.

E: ERROR character. Enter a user defined error replacement code. See under "Advanced Operation".

F: FEC set. Enable FEC receive mode with 1, disable it with 0.

I: IDENT set. Enter a four-letter ARQ selcal code (chosen from the letters of your callsign). If you enter a non A-Z character, a ? will be displayed, and the AMT-2 will be set so as not to respond to any selcal.

L: LOCAL set. Enable local copy with a 1, disable it with a 0.

N: NEWLINE set. Enable auto newline with a 1 and disable it with a 0.

Q: QUERY print. This command displays a line showing the current settings of all parameters. The first parameter on the line is the software version number.

R: RTTY mode. Before entering RTTY mode, ensure that the BAUD parameter has been first set to the required value.

S: SPEED set. Enter a 2 digit number between 01 and 99 to set the CW word per minute speed.

T: TIMOUT set. Enter a 2 digit number between 01 and 99 to set the timeout for ARQ contacts and calls.

X: XON/XOFF set. Enable the XON/XOFF function with a 1 and disable it with a 0.
See the ADVANCED OPERATION section for details.

Z: Test mode. There are eight tests available, selected by entering a single digit after the Z:-

0: Enables the tuning display, signal detector, and FSK demotor. Used to set up the demodulator centre frequency and input gain control.

1: Transmits a continuous mark tone. Used to set up the mark tone generator frequency.

2: Transmits a continuous space tone. Used to set up the space tone generator frequency.

3: Transmits a continuous centre frequency tone. Used to set transmit audio output level and set the CW transmit tone frequency.

4: Tests the front panel LED display by cycling through all the possible LED combinations.

5: Tests the 2048 byte RAM memory by cycling through all locations. If an error is detected, the ERROR LED is lit.

6: Checks the integrity of the program ROM. A good ROM will cause the printout "00", whereas a bad or mutiated ROM will give some other hex number.

7: Transmit/receive changeover test. Rapid cycling of the PTT line enables the transmit delay preset to be adjusted for optimum delay.

6) CONTROL CODES

Unlike the COMMAND letters, which always follow an ESCAPE key in COMMAND mode, these functions are used within the active modes of the AMT-2. They are normally executed by holding down the CONTROL key on the terminal keyboard and then keying a letter. With some terminal programs, these CONTROL functions may appear as function keys. Consult the instructions with your terminal program if in doubt.

NULL: Entering a NULL from the terminal will cause a NULL code to be sent over the radio in ASCII mode or an ALL SPACE code in RTTY and AMTOR modes. A NULL code received in RTTY or AMTOR will cause a NULL to be sent to the terminal.

A In AMTOR STBY, starts an ARQ call when followed by the 4 letter selcal code of the station to be called.

B In AMTOR STBY starts an FEC transmission.

C In AMTOR, RTTY and ASCII, forces a change to transmit. In CW, increases the speed in words per minute by 1.

D In AMTOR ARQ, terminates an ARQ contact or ends an FEC transmission. In RTTY and ASCII, changes to receive. In CW, it decreases the speed by 1 word per minute.

E Causes the AMT-2 to send the terminal a special code containing information covering the mode and status of the unit. See ADVANCED OPERATION section for further details.

F In AMTOR STBY initiates or resynchronises the ARQ LISTEN function.

G In RTTY and AMTOR, causes a BELL code to be sent over the radio. An asterisk character is echoed to the terminal.

L Toggles the LOCAL function, i.e. turns it off if it was on, and vice versa.

N Toggles the NEWLINE function, i.e. turns it off if it was on and vice-versa.

Q If the XON/XOFF function is on, this code turns on the traffic output from the AMT-2 to the terminal.

S If the XON/XOFF function is on, this code turns off the traffic output from the AMT-2 to the terminal.

X In any mode, this code will clear any unsent traffic from the er store and cancel the effect of any CONTROL C or CONTROL D keys previously pressed.

ESC This control code will unconditionally stop any activity and return the AMT-2 to COMMAND mode with the transmitter off.

7) OPERATING HINTS

RTTY and AMTOR modes use a code with 32 different combinations. Two of these are used to switch between one set of 30 letter characters and another set of figure characters and punctuation marks. The "letters" and "figures" codes are automatically generated by the AMT-2. In most cases the user need not be aware of the operation. However, it sometimes happens that the received text is in the wrong character set. If the received text appears in "figures" in error, enter a DEL (or RUBOUT) code from the terminal. This will force the following text back to "letters".

The AMT-2 has an automatic system for sending an extra "letters" or "figures" code after every CAR RET, LINEFEED or NULL code, which ensures that the distant station will always start a new line in the correct character set. This follows the traditional procedure of the mechanical teleprinter operator. Since the character set at the distant station will always be unknown at the start of a transmission, it is always good practice to begin each transmission with a CAR RET and LINEFEED. This forces the AMT-2 to send the correct "letters" or "figures" character. It also defines the print position at the distant receiver which will also be an unknown at the start of transmission.

In AMTOR FEC transmissions, the distant receiver can only synchronise when the transmitting station is idling. An intentional pause is therefore left by the AMT-2 at the commencement of an FEC transmission and at intervals of 4 secs thereafter. This allows stations tuning in late to "join in" halfway through a transmission (and also slows dowe character rate to that of a mechanical teleprinter).

However, if conditions are known to be poor, it can help to leave an extra pause before starting to type, as well as pauses between items. This give distant stations extra time to tune in and synchronise. While it is common practice to send a line of RYRYRY on RTTY to allow the distant receiver to be tuned in, it is far better on FEC to simply allow the transmission to idle for a few moments before starting to send traffic.

The internal buffer store can hold about 1900 characters. This is more than sufficient to allow the average operator to type ahead, even if the transmission speed is very slow. However, if the buffer does fill, traffic will be lost. If high-speed entry of long texts from a computer is contemplated, these must be either restricted to less that 1900 characters at a time, or the XON/XOFF function should be implemented, as described in the ADVANCED OPERATION section.

The normal way of commencing a contact in RTTY, ASCII or CW is to put out a CQ call. A reply will be received in the same mode and the contact will proceed in the same mode. If this sounds obvious, then bear in mind the procedure to be adopted in AMTOR. An AMTOR CQ call can only be made in FEC. It is therefore common practice to announce one's own selcal code during an FEC CQ call. On ending the call, a replying station wishing to make a contact will probably call back in ARQ mode. There are some conditions when ARQ contacts cannot be made at all, such as when the distance between the two stations in in excess of about 25,000 km, such as with certain "long path" routes on HF, or via high orbit satellites. In such cases, an attempt to start an ARQ contact will prove unsuccessful.

When making an ARQ call using a transceiver, it can happen that the replying station comes back slightly off tune, as indicated by an off centre tuning display. It is tempting to correct this error by adjustment of the main tuning dial. This temptation must be resisted, as it will result in the transmitter frequency changing as well. This will probably result in the distant station having to retune. This can result in an endless series of retune operations at both ends. The rule therefore, is for the calling station to leave his main tuning dial untouched, and to remove any offset with his receiver RIT (clarifier).

If, during the ensueing contact, relative drift between the two stations occurs, then it is the called station's responsibility to retune his main tuning dial to remove the effects of the drift. The calling station again leaves his main dial fixed and only adjusts the RIT. The reason for this convention is associated with the PHASE operation, in which the calling station repeats the selcal to try to re-establish the link. It is essential in this condition that it is known exactly which station is trying to retune to the other.

8) ADVANCED OPERATION

So far in the ription of the operation of the AMT-2, it has been assumed that a dumb terminal or dumb terminal program has been used. However, many users will wish to take advantage of the extra power in their computers to perform more complex operations. Several facilities exist in the AMT-2 to make this possible.

A) Error Replacement.

In RTTY, ASCII, CW, FEC receive, and ARQ LISTEN modes, the AMT-2 may for a variety of reasons already described, reject a received character, suppressing it from the output to the terminal and lighting the ERROR LED. The bad character is not actually suppressed completely, but is replaced by ASCII code 26 (hex 1A). On a dumb terminal this code will have no effect. If the terminal is an intelligent computer, good use can be made of this code. If detected, it can be replaced with a characteristic symbol to be displayed on the screen.

On some computers, reception of this ASCII code 26 (CONTROL Z) may have some special function. To circumvent problems of this sort, the error replacement character can be changed to any other in the range 00 to 31, by using the ESCAPE E command. Follow this command by any ASCII character between @ and "underline" (Hex 40 to 5F), and the error replacement character will then be set to the correct control code. Thus ESCAPE E Y will change the error code to CONTROL Y. The ESCAPE Q printout will change in that the E parameter will change to E;Y.

The choice of alternative error codes will depend on the computer used and the functions it might carry out with some codes, but obvious codes to avoid are CONTROL M and CONTROL J, which are the carriage return and line feed codes respectively.

B) Status Byte.

The terminal can at any time - even when traffic is stopped by the XON/XOFF function, send the AMT-2 a CONTROL E. The AMT-2 will then send back, at the earliest opportunity, a code that indicates its status. Considering the 8-bit code returned as separate bits, then they can be interpreted in the following way:-

Bits 0, 1, and 2 indicate which of the status LEDs are lit.

Bit 2	1	0	LED
0	0	0	ERROR
0	0	1	RQ
0	1	0	TFC
0	1	1	IDLE
1	0	0	OVER
1	0	1	PHASE
1	1	0	STBY
1	1	1	no status LEDs

Bit 3 indicates the state of the SEND LED, i.e. bit 3 will be 1 if the send LED is on.
Bits 4, 5, and 6 indicate which of the MODE LEDs are lit.

Bit 6	5	4	MODE
0	0	0	CMD
0	0	1	ARQ
0	1	0	FEC
0	1	1	RTTY
1	0	0	CW
1	0	1	ASCII
1	1	0	not used
1	1	1	not used

Bit 7 of the status code will always be 1. This is in contrast to any other code from the AMT-2, where bit 7 will always be 0. It enables the computer to distinguish between the requested status code and normal traffic characters which may be coming from the AMT-2 at the time.

The status code can be used in a variety of ways. For example, if it is desired to send the station callsign on CW at the end of an ARQ contact, then a routine can be built into the computer program to send a CONTROL D to the AMT-2. It then repeatedly sends CONTROL E until the status code returned indicates that the AMT-2 has reverted to STBY. Then it sends ESCAPE C followed by the station callsign followed by repeatedly sending CONTROL E again until the status code indicates that the buffer is empty. It can then leave the routine to carry out some other task.

Note that in AMTOR STBY mode, the SEND LED reflects the presence of a signal in the receiver. The computer can therefore test for a busy or free channel by entering ESCAPE A. It receives a status code and tests bit 3. This can be very useful to prevent inadvertent interference or to find a free channel if the transceiver is also under computer control.

C) XON/XOFF

In order to prevent the AMT-2 buffer from overflowing when sending long texts from the computer, the traffic flow control function can be turned on by sending ESCAPE X1 to the AMT-2. With XON/XOFF on: If the buffer becomes nearly full then the AMT-2 will send to the terminal an ASCII code 19 (Hex 13, or CONTROL S). This tells the computer to stop sending traffic. The computer, of course, must be programmed to do this.

Subsequently, when the buffer empties a little, ASCII code 17 (hex 11, or CONTROL Q) will be sent to terminal to tell the computer that it may resume sending traffic. There is a 5 character margin between the point at which the AMT-2 sends CONTROL S and the point at which the buffer fills completely. This allows the computer some time to respond to the CONTROL S signal.

In addition to the CONTROL Q and CONTROL S signals when the buffer is nearly full, the AMT-2 will send a CONTROL Q when it opens to accept text for transmission, such as when it leaves AMTOR STBY to ARQ contact or FEC transmit. It sends CONTROL S when reverting to STBY. It also sends CONTROL-Q when entering CMD mode to ensure that the terminal can send commands.

The XON/XOFF function also performs a similar job in the other direction. If the computer sends a CONTROL S to the AMT-2, then traffic from the AMT-2 will not be sent to the terminal. It will instead be saved in a small internal buffer which can hold up to 80 characters. This stored text may subsequently be read by the computer sending a CONTROL Q to the AMT-2.

This facility is useful when the computer must break off from handling the AMT-2 interface in order to carry out some other critical task, such as saving a section of text on disk or cassette. Note that because of the time taken to send the serial signals between the two units, the AMT-2 may continue to send for up to 3 characters after the computer starts to send a CONTROL S.

Note that if the computer takes so long on the other task that the 80 character buffer fills, then some received (or echoed) text will be lost. The exception is in AMTOR ARQ mode, where the AMT-2 will make dummy repeat requests to the distant station to prevent it sending any further traffic until it can be processed.

It will often be the case that the LOCAL and/or NEWLINE functions should turned off for a computer application and turned on again for manual use. Although these selections can be achieved with the ESCAPE L and ESCAPE N commands, this can only be done in the COMMAND mode. As an alternative, which can be done whilst another mode (such as AMTOR ARQ) is running, the CONTROL L and CONTROL N functions can be used to turn the LOCAL and NEWLINE functions on and off. The computer must keep track of which state it has left these selections in.

9) ALIGNMENT

Although the AMT-2 has ben accurately set up in the factory and should need no internal adjustments apart from those already described in the SETTING UP section, details are given below of the method of adjustment of the remaining internal pre-sets.

A counter capable of measuring audio and radio frequencies and an audio frequency generator or suitable variable tone source are required.

Crystal trimmer.

With the aid of an accurate 6 digit counter, adjust VC1 until the signal on TP5 is 1228.800 kHz. This adjustment should be made to an accuracy of 30Hz or better.

Demodulator centre frequency.

Inject a sinewave from an audio signal generator into the audio input and key ESCAPE Z 0. With the aid of the counter, set the frequency to 1360 Hz (2210 Hz for North American version). Raise the signal generator output level until the SEND LED lights. Adjust VR7 until the point is reached where the ERROR and RQ LEDS are both lit. Check that the tuning display is central at this point.

FSK generator.

Connect the counter to the audio output of the AMT-2 and key ESCAPE Z3. Adjust VR2 for a frequency reading of 1360Hz (2210Hz for the USA version). Next key ESCAPE Z 1 (Z2, USA) and adjust VR1 for a reading of 1445 Hz (2295 Hz USA). Next key ESCAPE Z2 (Z1, USA) and adjust VR6 for a reading of 1275 Hz (2125 USA).

Although not part of the AMT-2 alignment, the adjustment of VR4 to the requirements of a particular transceiver using an oscilloscope is given here. Connect the oscilloscope so as to display the RF output across the dummy load with external trigger from the PTT line. Set the oscilloscope to external trigger, neegative slope and a timebase speed of 10mS per division. Turn VR4 fully clockwise and key ESCAPE Z7.

Observe the point on the oscilloscope display at which the RF output first appears, which should be about 50mS from the left hand end of the trace. Turn VR4 anti-clockwise and observe that the RF start moves to the left. Continue to turn VR4 until the RF start moves no further to the left, then back the preset a little, aiming for the point where the RF start is just controlled by the preset.

Making this adjustment as accurately as possible will maximise the distance which can be worked on ARQ mode. The longer the delay setting, the shorter becomes the maximum range workable. It reduces by 1500 km for each increase of 10mS in the delay setting.

10) AMTOR BASIC THEORY

Teleprinter communication over radio links has always been achieved via frequency-shift-keying of the transmitter carrier frequency, the higher frequency representing one logic level and the lower, the other. In traditional RTTY, 32 characters are transmitted by various combinations of 5 data bits, transmitted serially and preceeded by a start bit which synchronises the receiver decoding. It is separated from the following character by a stop bit. This system, although usually generated and decoded in modern equipment electrically, was originally designed to be decoded mechanical and suffers from problems when used on radio links which are subject to fading and interference. Any such interference or noise which causes a data bit to be received in the wrong polarity results in an incorrectly printed character. Furthermore, the start-stop technique used often results in several characters being in error if a start-bit is mutilated.

The conceptual basis of the TOR system is that steps are taken to ensure that an error in the received signal does not necessarily cause an error in the output character. This is done by transmitting extra information along with the data, which enables the distant receiver to detect the presence of errors. Instead of 5 data bits, 7 are transmitted. Three bits are of one polarity and four are of the other. The vast majority of randomly-occuring errors result in this 3:4 ratio being altered at the receiver, enabling the receiving station to detect that the data is erroneous.

There are 35 possible combinations of 7 bits, and 32 of these are translated directly to the standard RTTY character set. Others are used as special control characters. The start-bit mutilation problem is overcome by transmitting the data bits synchronously at accurately-controlled intervals. The synchronisation at the receiver is achieved by accurately-controlled timing rather than by using a start bit.

There are two different types of communication available in AMTOR. Forward Error Correction (FEC), and Automatic Request (ARQ). In the FEC mode. the 7 bit characters are transmitted twice, and the receiving station can choose which of the two passes the 3:4 ratio test. Up to half of the received codes can therefore be in error before errors occur in the output. The second transmission of each character is ded relative to the first, so that a prolonged fade or burst of interference will only result in one transmission of several characters being mutilated, rather than both transmissions of a few adjacent characters. Even if both transmissions are mutilated, the receiving station prevents an erroneous character being printed, suppressing the character completely and signalling the presence of the error via the ERROR lamp.

In ARQ mode, the transmitter sends a group of three 7-bit characters in a block. The distant receiver examines each one, and if any contains an error, an automatic request to repeat the whole block is made. In this case, the receiving station sends a repeat request character to the transmitting station. In this way interference or fading does not generally result in errors, but merely a slowing-down of the transmission of information each time a repeat is requested. Data blocks and control-codes are transmitted back and forth by the two stations working in quick break fashion, usually on the same frequency. This gives rise to the familiar chirp-chirp-chirp of AMTOR signals on the air.

In both FEC and ARQ modes, accurate synchronisation is essential between both ends of the link, and this is achieved by special phasing signals transmitted at the start of each contact, and maintained by crystal-controlled timing.

In practice, it is possible for errors to occasionally "beat" the 3:4 ratio check, and result in printed errors. Nevertheless, FEC is considerably better than conventional RTTY, and ARQ is very much better than FEC. The reason for including both FEC and ARQ features is that ARQ can only, by its nature, be used between two co-operating stations, whereas FEC can be transmitted by one station to any number of stations. Thus FE often used for broadcast messages such as news bulletins and CQ calls.

In the ARQ mode, it is necessary to know the identity of the other station before establishing the contact, hence FEC is often used at the start of a contact, followed by a change to ARQ. The requirement to identify the intended ARQ contact first arises from the initial process which is required at the start of the contact. This feature also enables the ARQ mode to be used to selectively contact one particular station among a number who may be monitoring a common frequency.

As well as the facility to transmit and receive FEC signals and make or receive calls in ARQ mode, the AMT-2 has a facility to enable it to monitor one side of an ARQ contact between two other stations. This ability is not inherent in the ARQ system itself, but is included since it is always interesting to be able to listen-in to other contacts.

Apart from the AMTOR, the AMT-2 can also operate in conventional RTTY mode both in transmit and receive. It can also be used to send and receive morse code (CW).

11) TRANSCEIVER CHANGEOVER PERFORMANCE

In ARQ and CW modes, a reasonably fast changeover from transmit to receive and vice versa is essential. If your transceiver takes longer than 50mS to change from receive to transmit, then it will not be possible to find a setting for VR4 that will allow the AMT-2 to operate in ARQ mode correctly. Even if the changeover time is less than 50mS and it is possible to set VR4, it may be necessary to modify the transceiver to shorten the delay time as much as possible.

The shorter the delay time, the greater will be the maximum distance that can be worked in ARQ mode. This is because radio waves take a finite time to travel, and the ARQ mode allows a maximum of 170mS for the radio signals to travel from one son to the other and back. If there were no other delays, this would give a maximum distance of 170 x 300 km between ARQ stations. Since radio waves travel at 300 km per mS, this would give a maximum distance of 25,500 km. The ARQ mode cannot work at a greater distance. Any additional delays will reduce this range, and it is for this reason that the shortest possible changeover delay is advantageous.
With changeover delays of 10mS at both ends, it is just possible to work from one point of the globe to the antipodeal point.

Most transceivers perform well in this respect, especially the more modern ones and those noted for fast break-in CW. However, some require small modifications to be able to change over faster.

The first approach is to contact your transceiver dealer, who may already have details of the necessary modifications and can either carry them out or supply the necessary modification kit or information. In the absence of such help, contact other AMTOR operators who may already have devised modifications on the same type of equipment. As a last resort, obtain the service handbook or circuit diagram, and, with the aid of an oscilloscope, trace the path taken by the signal from the microphone socket through to the transmitter output, synchronising the scope from the PTT line, and observing the time interval immediately after the PTT line goes low, looking for any source of excessive delay.

It may often be found that excessive delays occur due to the charging-up of large capacitors - either those bypassing supply lines that are switched on or off between receive and transmit, or those coupling signals between stages that are operating from differently-switched supply lines.

The cure is usually to reduce the value of the offending capacitor. In some cases, it may be possible to move part of the circuitry, for example the microphone pre-amplifier, from a supply line that is switched, to one that is not, without affecting the performance of the transceiver. Experience has shown that the speed of operation of relays is quite adequate, except possibly some very large relays in high power amplifiers.

The speed of changeover from transmit to receive is also important in ARQ mode. More especially for a station making the initial call when working a nearby station - when the reply has to be received very soon after the end of the transmit burst. If problems are encountered when trying to initiate such a contact, but not when the other station initiates the call from his end, then suspect thae receiver is taking too long to switch back to full gain after the transmitter burst.

Again, the transceiver dealer, manufacturer, or other AMTOR users may be able to provide the solution.
A similar analysis technique to that used for the transmitter may be used, but this time triggering the oscilloscope from the trailing edge of the PTT signal and tracing the signals through the receiver.
Look for the effects of large capacitors in decoupling, coupling, or AGC positions. It is also possible that some relays may be slow to drop back to the receive condition if a diode is connected across the relay coil to supress back EMF spikes. This has the effect of slowing the drop out of the relay. The cure is to add a resistor in series with the diode with a value equal to that of the relay coil impedance.

12) CODE TRANSLATION TABLES.

Data bits are transmitted left to right. In ASCII, the parity bit is always 0

CODE	CHAR.	RTTY	ASCII	AMTOR	CW
0	NULL	00000	0000000	0101011	
(Codes 1 to 9 not programmed)					
10	L/F	00010	0101000	0011011	
(Codes 11 and 12 not programmed)					
13	C/R	01000	1011000	0001111	
(Codes 14 to 31 not programmed)					
32	SPACE	00100	0000010	0011101	
33	!		1000010		-.-.-
34	"		0100010		.-..-.
35	#	00101	1100010	1001011	...-.-
36	$	10010	0010010	1100101	
37	%	10110	1010010	1101100	
38	&		0110010		
39	'	10100	1110010	1101001	.----.
40	(	11110	0001010	0111100	-.--.
41	)	01001	1001010	1010011	-.--.-
42	*	11010	0101010	1110100	.-.-.
43	+	10001	1101010	1100011	...-.
44	,	00110	0011010	1001101	--..--
45	-	11000	1011010	1110001	-....-
46	.	00111	01110.0	1001110	.-.-.-
47	/	10111	1111010	0101110	-..-.
48	0	01101	0000110	1011010	-----
49	1	11101	1000110	0111010	.----
50	2	11001	0100110	1110010	..---
51	3	10000	1100110	0110101	...--
52	4	01010	0010110	1010101	....-
53	5	00001	1010110	0010111	.....
54	6	10101	0110110	1101010	-....
55	7	11100	1110110	0111001	--...
56	8	01100	0001110	1011001	---..
57	9	00011	1001110	1000111	----.
58	:	01110	0101110	1011100	
59	;		1101110		-.-.-.
60	<		110		
61	=	01111	1011110	0011110	-...-
62	>		0111110		.-...
63	?	10011	1111110	0100111	..--..
64	@	01011	0000001	1010110	

CODE	CHAR.	RTTY	ASCII	AMTOR	CW
65	A	11000	1000001	1110001	.-
66	B	10011	0100001	0100111	-...
67	C	01110	1100001	1011100	-.-.
68	D	10010	0010001	1100101	-..
69	E	10000	1010001	0110101	.
70	F	10110	0110001	1101100	..-.
71	G	01011	1110001	1010110	--.
72	H	00101	0001001	1001011	....
73	I	01100	1001001	1011001	..
74	J	11010	0101001	1110100	.---
75	K	11110	1101001	0111100	-.-
76	L	01001	0011001	1010011	.-..
77	M	00111	1011001	1001110	--
78	N	00110	0111001	1001101	-.
79	O	00011	1111001	1000111	---
80	P	01101	0000101	1011010	.--.
81	Q	11101	1000101	0111010	--.-
82	R	01010	0100101	1010101	.-.
83	S	10100	1100101	1101001	...
84	T	00001	0010101	0010111	-
85	U	11100	1010101	0111001	..-
86	V	01111	0110101	0011110	...-
87	W	11001	1110101	1110010	.--
88	X	10111	0001101	0101110	-..-
89	Y	10101	1001101	1101010	-.--
90	Z	10001	0101101	1100011	--..
91	[		1101101		.-.-
92	\		0011101		---.
93	]		1011101		.--.-
94	^		0111101		
95	_		1111101		
96	`		0000011		

SAMPLE DRIVER PROGRAMS FOR POPULAR HOME COMPUTERS

1. BBC model B
2. Commodore 64
3. VIC-20

Note: If you wish to use any other computer which is equipped with a serial interface, it is usually best to use a "Terminal Emulation Program". This is normally available from the computer manufacturer. Failing this, a program written in Basic and modelled on one of the following programs should suffice.

The computer should be programmed such that the serial interface is operating at 300 Bauds, full duplex.

CODE	CHAR.	RTTY	ASCII	AMTOR	CW
97	a	11000	1000011	1110001	.-
98	b	10011	0100011	0100111	-...
99	c	01110	1100011	1011100	-.-.
100	d	10010	0010011	1100101	-..
101	e	10000	1010011	0110101	.
102	f	10110	0110011	1101100	..-.
103	g	01011	1110011	1010110	--.
104	h	00101	0001001	1001011	....
105	i	01100	1001011	1011001	..
106	j	11010	0101011	1110100	.---
107	k	11110	1101011	0111100	-.-
108	l	01001	0011011	1010011	.-..
109	m	00111	1011011	1001110	--
110	n	00110	0111011	1001101	-.
111	o	00011	1111011	1000111	---
112	p	01101	0000111	1011010	.--.
113	q	11101	1000111	0111010	--.-
114	r	01010	0100111	1010101	.-.
115	s	10100	1100111	1101001	...
116	t	00001	0010111	0010111	-
117	u	11100	1010111	0111001	..-
118	v	01111	0110111	0011110	...-
119	w	11001	1110111	1110010	.--
120	x	10111	0001111	0101110	-..-
121	y	10101	1001111	1101010	-.--
122	z	10001	0101111	1100011	--..
123	{		1101111		
124	|		0011111		
125	}		1011111		
126	~		0111111		
127	(Not programmed)				

AMT-2 DRIVER FOR COMMODORE 64

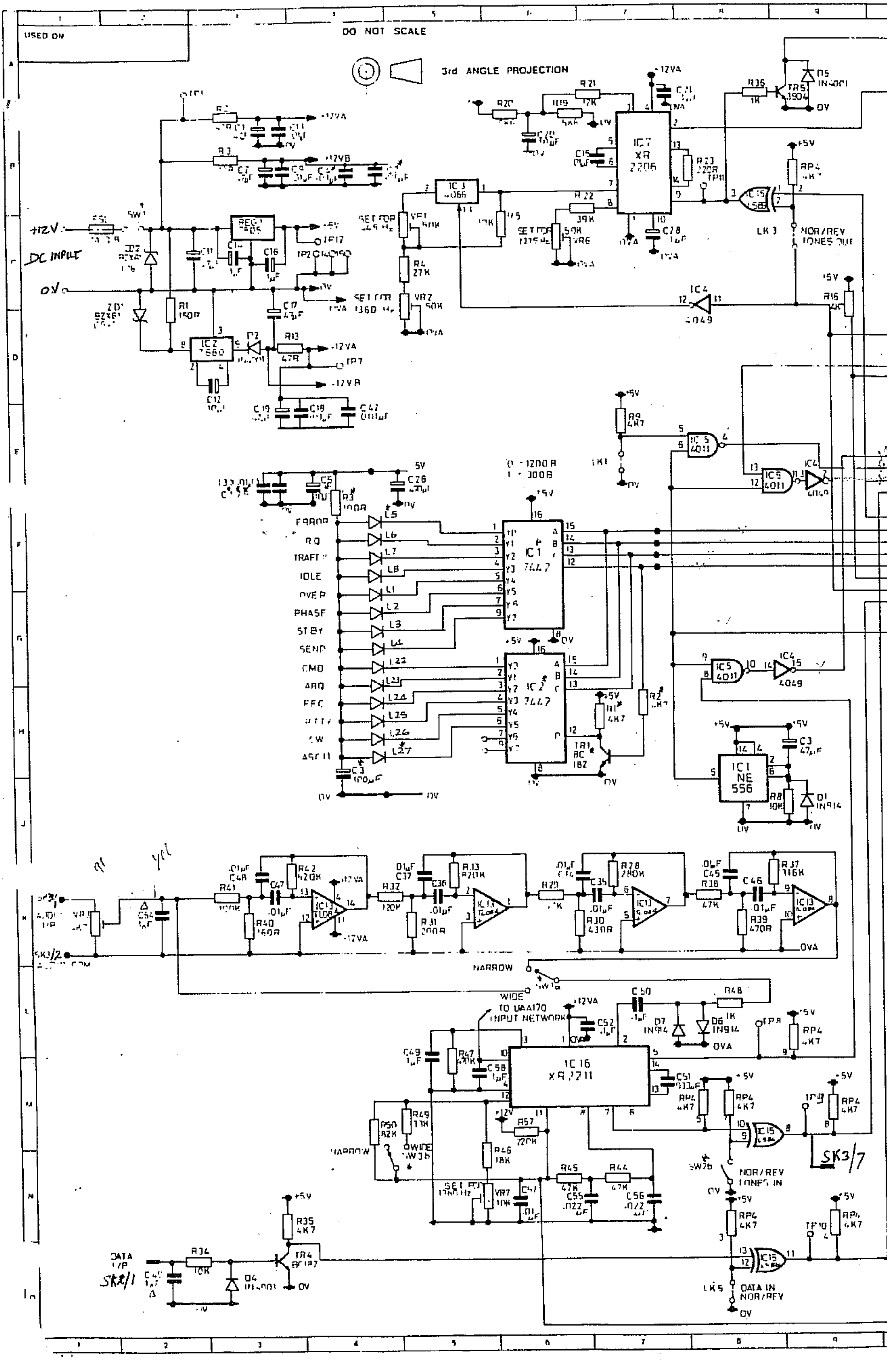
```
10 POKE650,128:US=0:DE=0
20 PRINT"[CLS]";:OPEN128,2,0,CHR$( 6 )+CHR$(0)
25 POKE56577,0
30 IFDE<>0THENDE=0:A$=CHR$(127):GOTO200
35 GETA$:IFA$=""THEN210
40 IFA$="[BLK]"THENCLOSE128:POKE650,0:END
45 IFA$="[F1]"THENA$=CHR$(27):GOTO200
50 IFA$="[F2]"THENA$=CHR$(3):GOTO200
60 IFA$="[F3]"THENA$=CHR$(1):GOTO200
70 IFA$="[F4]"THENA$=CHR$(24):GOTO200
80 IFA$="[F5]"THENA$=CHR$(4):GOTO200
90 IFA$="[F6]"THENA$=CHR$(2):GOTO200
100 IFA$="[F7]"THENA$=CHR$(6):GOTO200
110 IFA$="[F8]"THENA$=CHR$(127):GOTO200
120 IFA$=CHR$(13)THENPRINT#128:GOTO210
130 IFA$="[REV]"THENUS=-1:GOTO210
140 IFA$="[OFF]"THENUS=0:GOTO210
150 IFA$="[CLS]"THENPRINT"[CLS]";:GOTO210
160 IFA$="[CD]"THENPOKE56577,255:GOTO210
170 IFA$="[CR]"THENPOKE56577,0:GOTO210
190 IFA$<"[SPC]"ORA$>"←"THEN30
200 PRINT#128,A$;
210 GET#128,B$:IFB$=""THEN30
215 IFASC(B$)>127THEN30
220 IFB$=CHR$(13)THENDE=US:GOTO240
225 IFB$<>"[SPC]"THEN240
230 DE=US:IFPOS(0)>32THENPRINT:GOTO30
240 PRINTB$;
250 GOTO30
```

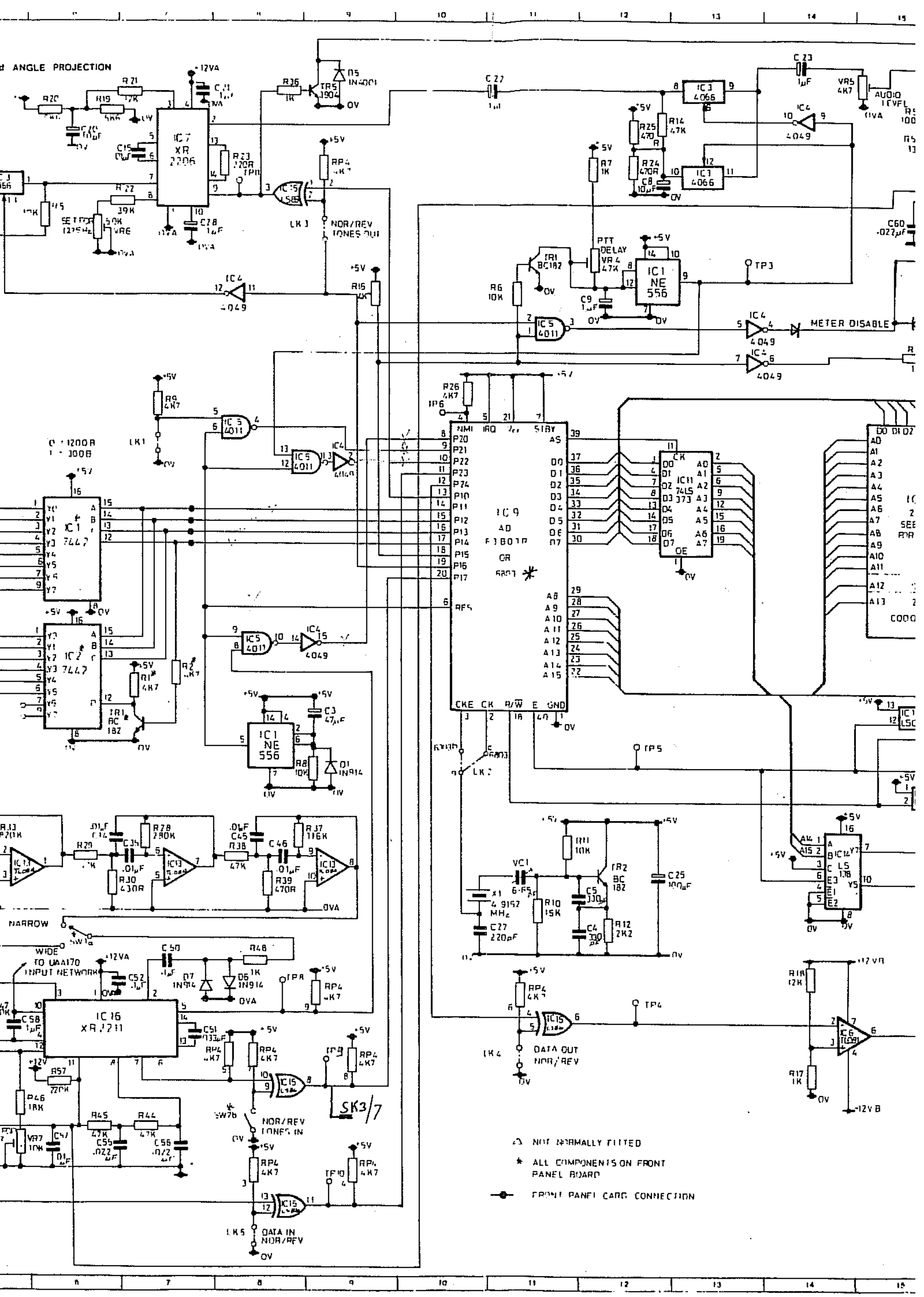
THIS LISTING WAS PRODUCED USING THE C64-CT FORMAT CONVERTER

NOTE: This uses the same function key assignments as the VIC-20 program.

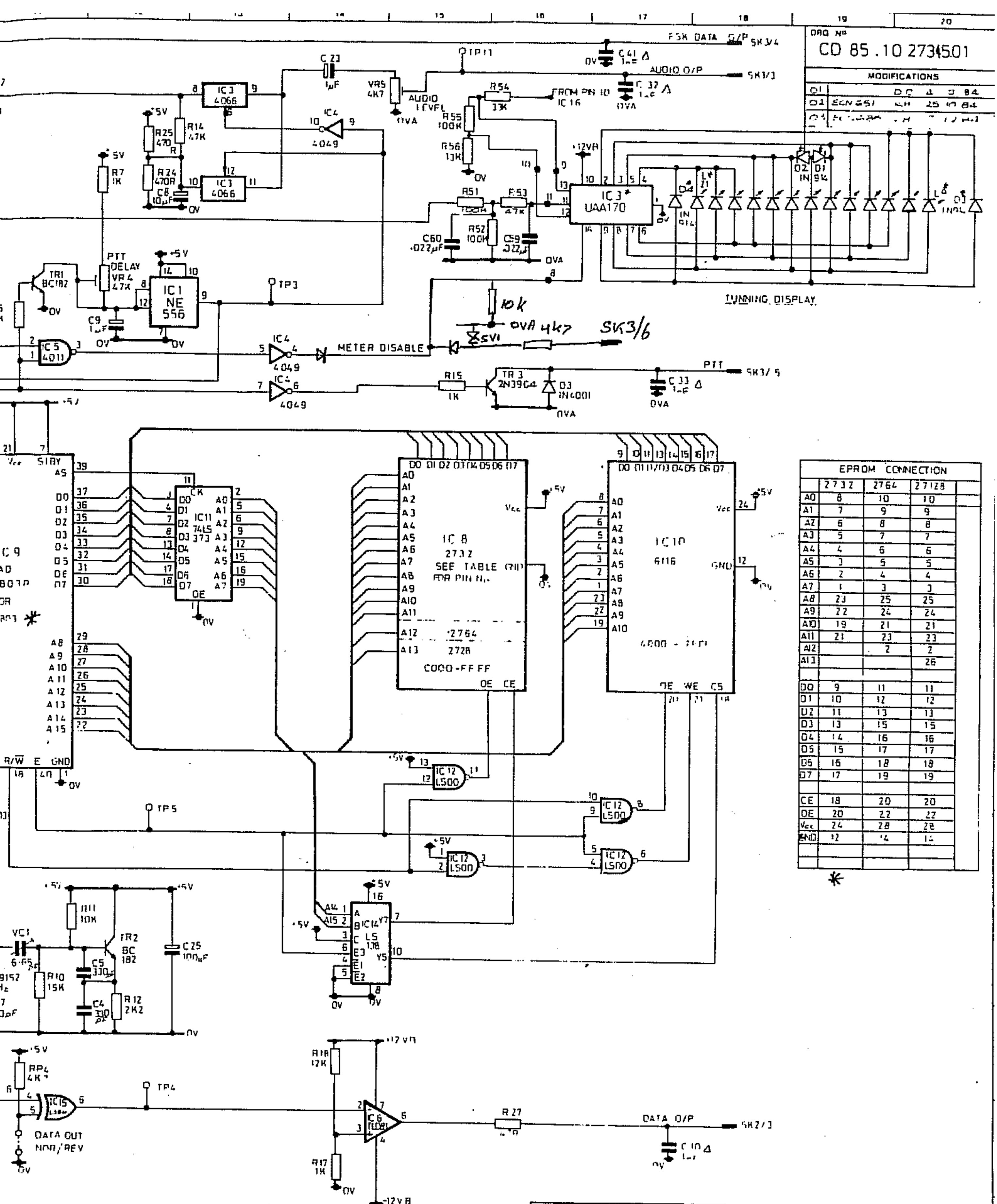
```
10 REM AMT-2 DRIVER FOR BBC OS1.0 OR LATER
20 REM AMT-2 SET TO 300 BAUD
30 REM STRAP RTS TO CTS ON BBC RS423 SOCKET
40 REM F0 TURNS CENTRONICS PRINTER OFF
50 REM F1 TURNS CENTRONICS PRINTER ON
60 REM F2 SENDS ESCAPE TO AMT-1
70 REM USE ESCAPE KEY TO EXIT PROGRAM
80 REM error% is ASCII code of error character displayed
90 error%=124
100 *FX5,1
110 *FX7,3
120 *FX8,3
130 *FX225,140
140 *FX4,1
150 ON ERROR GOTO 540
160 REPEAT
170 X=FNkey:IF X>0 THEN PROCkeyboard(X)
180 X=FNinput
190 IF X=26 THEN X=error%
200 IF X>0 THEN PROCvdu(X)
210 UNTIL FALSE
220 DEFPROCkeyboard(J)
230 IF J>127 THEN PROCfunction(J) ELSE PROCoutput(J)
240 ENDPROC
250 DEF FNkey
260 *FX2,2
270 =INKEY(0)
280 DEF FNinput
290 *FX2,1
300 =INKEY(0)
310 DEFPROCvdu(J)
320 *FX3,0
330 PRINT CHR$(J);
340 ENDPROC
350 DEFPROCoutput(J)
360 *FX3,7
370 PRINT CHR$(J);
380 IF J=13 THEN PRINT CHR$(10);
390 ENDPROC
400 DEFPROCfunction(J)
410 IF J=140 THEN PROCprintoff:ENDPROC
420 IF J=141 THEN PROCprinton:ENDPROC
430 IF J=142 THEN PROCoutput(27):ENDPROC
440 REM ADD OTHER FUNCTION KEY ROUTINES HERE
450 ENDPROC
460 DEFPROCprinton
470 *FX3,4
480 VDU2
490 ENDPROC
500 DEFPROCprintoff
510 *FX3,4
520 VDU3
530 ENDPROC
540 VDU3
550 *FX2,0
560 *FX3,0
570 *FX4,0
580 *FX225,1
590 ON ERROR OFF
600 REPORT:PRINT " line "ERL
610 END
```

```
1 REM *** PROGRAM TO ENABLE VIC-20 WITH RS-232 INTERFACE TO BE USED WITH AMT-2
MTOR TERMINAL UNIT..
2 REM  *** THIS PROGRAM USES THE FUNCTION KEYS TO PRODUCE THE NECESSARY CONTRO
KEYS...
3 REM ***  F1 = ESCAPE
4 REM ***  F2 = CTRL C
5 REM ***  F3 = CTRL A
6 REM ***  F4 = CTRL X
7 REM ***  F5 = CTRL D
8 REM ***  F6 = CTRL B
9 REM ***  F7 = CTRL F
10 REM***  F8 = RUBOUT (ERASE)
11 REM *** PROGRAM WRITTEN BY D.J.INGLEDEW (G8AXZ)

15 REM **** CLEAR SCREEN ,OPEN RS232 CHANNEL AND SET BAUD RATE ETC.
20 PRINT"<CLR>":OPEN 2,2,3,CHR$( 6 ) + CHR$(0)

25 REM **** CHECK FOR KEY DEPRESSION..
30 A = PEEK(203) : IF A = 64 THEN 210

35 REM **** CHECK FOR FUNCTION KEY DEPRESSION ..
40 IF A = 39 THEN K = 1: GOTO 90
50 IF A = 47 THEN K = 3: GOTO 90
60 IF A = 55 THEN K = 5: GOTO 90
70 IF A = 63 THEN K = 7: GOTO 90

75 REM **** FUNCTION KEY NOT PRESSED, GET CHARACTER FROM KEYBOARD
80 GOTO 190

85 REM ***** CHECK IF SHIFT KEY WAS DEPRESSED..
90 B = PEEK(653) : IF B > 1 THEN B = 0
100 K = K + B

105 REM ****  ALLOCATE CONTROL CODES TO FUNCTION KEYS >>>
110 IF K = 1 THEN A$ = CHR$(27) : GOTO 200
120 IF K = 2 THEN A$ = CHR$(03) : GOTO 200
130 IF K = 3 THEN A$ = CHR$(01) : GET Z$ : GOTO 200
140 IF K = 4 THEN A$ = CHR$(24) : GOTO 200
150 IF K = 5 THEN A$ = CHR$(04) : GOTO 200
160 IF K = 6 THEN A$ = CHR$(02) : GOTO 200
170 IF K = 7 THEN A$ = CHR$(06) : GOTO 200
180 IF K = 8 THEN A$ = CHR$(127) : GOTO 200

185 REM **** IF NOT A CONTROL CODE THEN GET CHARACTER FROM KEYBOARD..
190 GET A$

195 REM **** SEND CHARACTER TO RS-232 PORT
200 PRINT#2,A$;

205 REM ****  GET CHARACTER FROM RS-232 PORT
210 GET#2,B$    :REM GETS CHARACTER FROM RS-232 PORT


215 REM PRINT CHARACTER ON VDU..
220 PRINT B$;
230 GOTO 30
```


USED ON
DO NOT SCALE
3rd ANGLE PROJECTION
+12V
DC INPUT
0V
SW1
FS1
REG1
7805
+5V
TP17
R1
150R
IC2
7660
+12VA
+12VB
TP7
R13
47R
C12
10µF
C17
47µF
C19
C18
C42
0.01µF
R2
R3
IC3
4066
SET FOR
VR1
50K
R4
27K
VR2
50K
SET FOR
1360 Hz
0VA
R20
R19
56K
R21
12K
C20
10µF
C15
IC7
XR
2206
R23
220R
TP11
R22
39K
SET FOR
VR6
50K
C28
1µF
R36
1K
TR5
D5
IN4001
RP4
4K7
IC15
LK3
NOR/REV
TONES OUT
R16
IC4
4049
R9
4K7
LK1
IC5
4011
0 - 1200B
1 - 300B
C26
470µF
ERROR
RQ
TRAFFIC
IDLE
OVER
PHASE
STBY
SEND
CMD
ARQ
FEC
CW
ASCII
L5
L6
L7
L8
L1
L2
L3
L4
L22
L23
L24
L25
L26
L27
IC1
7447
IC2
7447
R1
4K7
R2
4K7
TR1
BC
182
IC1
NE
556
C3
47µF
R8
10K
D1
IN914
SK3/1
AUDIO I/P
SK3/2
C48
R41
100K
C47
R42
420K
R40
160R
IC13
TL084
+12VA
-12VA
C37
C36
R32
120K
R31
200R
R33
820K
R29
C34
C35
R28
280K
R30
430R
C45
C46
R38
47K
R37
116K
R39
470R
NARROW
WIDE
SW1a
TO UAA170
INPUT NETWORK
C50
R48
1K
D7
IN914
D6
IN914
TP8
C52
C49
1µF
R47
C58
1µF
IC16
XR 2211
C51
R50
82K
R49
33K
SW3b
R57
220K
R46
18K
R45
47K
R44
47K
C55
.022µF
C56
.022µF
VR7
10K
SET FOR
1360 Hz
SW7b
NOR/REV
TONES IN
SK3/7
DATA
I/P
SK2/1
R34
10K
D4
IN4001
R35
4K7
TR4
BC107
LK5
DATA IN
NOR/REV
TP10



ANGLE PROJECTION
IC7 XR 2206
NOR/REV TONES OUT
PTT DELAY VR4 47K
IC1 NE 556
METER DISABLE
AUDIO LEVEL
IC9 AD F3B01P OR 6803
IC11 74LS 373
IC16 XR 2211
NARROW
WIDE
TO UAA170 INPUT NETWORK
NOR/REV TONES IN
DATA IN NOR/REV
DATA OUT NOR/REV
SK3/7
NOT NORMALLY FITTED
ALL COMPONENTS ON FRONT PANEL BOARD
FRONT PANEL CARD CONNECTION



EPROM CONNECTION			
	2732	2764	27128
A0	8	10	10
A1	7	9	9
A2	6	8	8
A3	5	7	7
A4	4	6	6
A5	3	5	5
A6	2	4	4
A7	1	3	3
A8	23	25	25
A9	22	24	24
A10	19	21	21
A11	21	23	23
A12		2	2
A13			26
D0	9	11	11
D1	10	12	12
D2	11	13	13
D3	13	15	15
D4	14	16	16
D5	15	17	17
D6	16	18	18
D7	17	19	19
CE	18	20	20
OE	20	22	22
Vcc	24	28	28
GND	12	14	14

*

Δ NOT NORMALLY FITTED

* ALL COMPONENTS ON FRONT PANEL BOARD

⊸ FRONT PANEL CARD CONNECTION

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MATERIAL		FINISH	
DIMS IN:	SCALE:	DRAWN D O	DATE 4 10 84
TOLERANCE		CHECKED AEE	APP'V D

TITLE: AMT 2 TERMINAL LOGIC

DRG Nº CD 85.1027345.01

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