TONO

Θ - 777

INSTRUCTION MANUAL

P R E C A U T I O N S

1. Operate the unit with supply voltage DC 11 – 14 V. Do not connect to an AC power source for commercial use.

2. The Θ-777 is designed against noises for communication use, however, some computers may generate large noises which interfere a transceiver. Please contact the manufacturer or the dealer of the computer in such case.

3. Never open the upper case unnecessarily. Do not touch the parts or terminals inside.

4. It is suggested the unit be placed in a dry place, avoiding direct sun and dust.

5. Please refer to the instruction manual of the computer as well as of the Θ-777 to connect and operate them adequately.

6. When you use a Baudot terminal, press the "BLANK" key where [**ESC**] is indicated in this manual in order to output 'BLANK' code as the 'ESC' code is not available with the Baudot terminal.

NOTE: Certain keyboard commands require pressing two keys simultaneously. Such commands are denoted in this manual as, for example, [**CTRL-X**]. Other commands require pressing two keys, one after other, but separately. Such commands are denoted as , for example, [**ESC**] [**I**].

TABLE OF CONTENS

FEATURES OF Θ-777

The Θ-777 is the most advanced code converter of high performance designed with TONO's computer technology. The unit supports completely automatic send/receive of Morse Code (CW), Baudot Code (RTTY), ASCII Code (RTTY), JIS Code (RTTY), Bit Inversion (RTTY) and new AMTOR (ARQ/FEC/SEL-FEC).

Interface

The built-in RS232 and TTL level interface enables you to use in combination with most of the computers or terminals. You can add features depending on the software of the computer.
(ASCII 100 – 200 bauds, Baudot 45.5 – 200 bauds)

Automatic Mode Selection Feature

The mode, the speed and polarity of RTTY signal (Baudot, ASCII, JIS, Nit Inversion) can be automatically judged with the Θ-777.

SELCAL (Selective Calling) System

With the feature the unit only receives messages following the preset code.

Wide Range of Transmitting and Receiving

Morse Code transmitting speed can be set from the keyboard at any rate between 5 – 100 WPM (words per minute). AUTOTRACK on receive. For communication in Baudot and ASCII Codes, rate is variable by keyboard instruction between 12 – 200 bauds when using RTTY Modem and between 12 – 600 bauds using TTL level.

Built-in Message Memory / Buffer Memory

Built-in Message Memory covering 64 characters × 4 channels, 32 characters × 7 channels and 16 characters × 4 channels and a 768-character input buffer memory is available with the unit. Messages in the memory can be recalled from a keyboard instruction. You can write messages into any channels while receiving.

CW Identification

In RTTY modes, keyboard-controlled CW identification is available if required.

Automatic Idle Signal Insertion

Idle signal (letters code) can be automatically inserted in a pause of transmission in BAUDOT-RTTY Mode.

"ECHO" Function

With a keyboard instruction, received data can be read and sent out to the keying jacks or AFSK jack at the same time. This function enables a cassette tape recorder to be used as a back-up memory.

Automatic CR/LF

While transmitting, CR/LF is automatically sent every 64, 72 or 80 characters, as selected.

Pre-load Function

The buffer memory can store the message written from the keyboard instead of sending them immediately. The stored message can e sent with a keyboard command.

"RUB-OUT" Function

You can correct mistakes while writing messages in the buffer memory. Misspellings can also be erased while the information is still in the buffer memory.

CW Random Generator

Output of CW random signal can be used as CW reading practice.

Variable CW Weights

For CW transmission, weights (ratio of dot to dash) can be changes within the limits of 1:3 – 1:7.

Test Message Function

"RY" and "QBF" test messages can be repeated with this function.

Function Display System

Each function (mode, tone, shift, speed etc.) is displayed on the screen.

Mark-and-Break (Space-and-Break) System

Either mark or space tone can be used to copy RTTY.

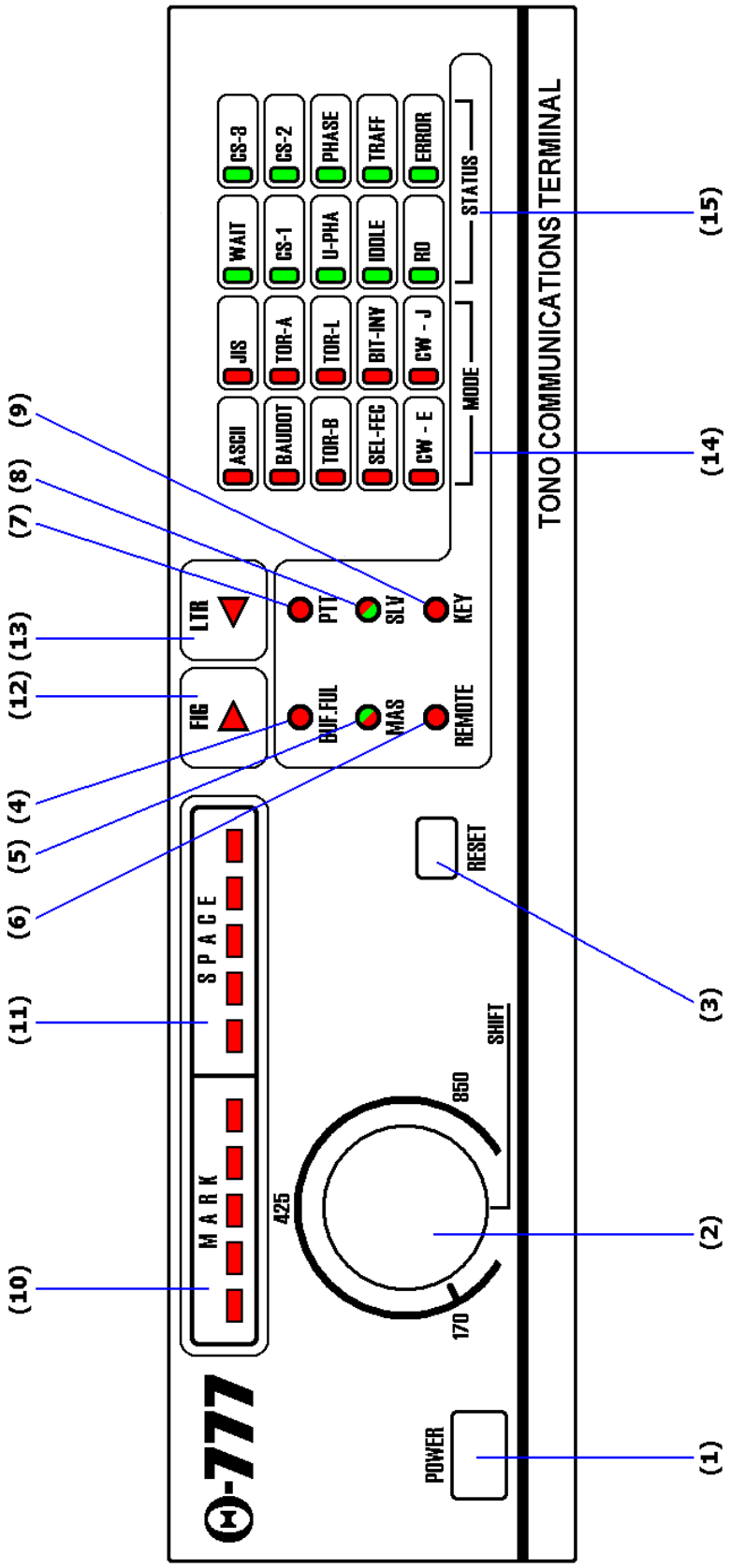
Crystal Controlled AFSK Modulator

A transceiver without FSK function can transmit RTTY Mode by utilizing the high stability crystal-controlled modulator controlled by the computer.

1. INSTALLATION

1.1 Front Panel Controls and Indicator

This section will assist you in becoming familiar with the switches and indicators on the front panel.



(1) [POWER] switch: controls all power to the unit.

(2) SHIFT volume: adjust shift width within the range of 170 Hz to 850 Hz for RTTY Modes.

NOTE: The figures printed around the volume such as '425' or '850' will give you a guidance on the rough tuning position.

(3) [RESET] switch: initialize the unit.

(4) BUF.FUL LED:* indicates that the buffer is filled with messages.

(5) MAS LED: illuminates when your station is MS (Master Station);
red: when your station is ISS (Information Sending Station) in Mode A or on transmitting side in Mode B.
green: when your station is IRS (information Receiving Station) in Mode A.

(6) REMOTE LED: indicates that the REMOTE jack is on.

(7) PTT LED: indicates that the PTT jack is on.

(8) SLV LED: illuminates when your station is SS (Slave Station);
red: when your station is ISS.
green: when your station is IRS in Mode A or on receiving side in Mode B.

(9) Key LED: indicates that the keying jack is on.

(10) MARK LED: indicates tuning of mark filter.

(11) SPACE LED: indicates tuning of space filter.

(12) FIG LED: indicates that FIGURE case is selected in the Bit Inversion, Baudot and AMTOR modes or that Japanese Morse Code is selected in the CW Mode.

(13) LTR LED: indicates that LETTER case is selected in the Bit Inversion, Baudot and AMTOR Modes or that Continental Morse Code is selected in the CW Mode.

(14) MODE LED: indicates the selected mode respectively.

(15) STATUS LED's: indicates the status in the AMTOR Modes respectively.

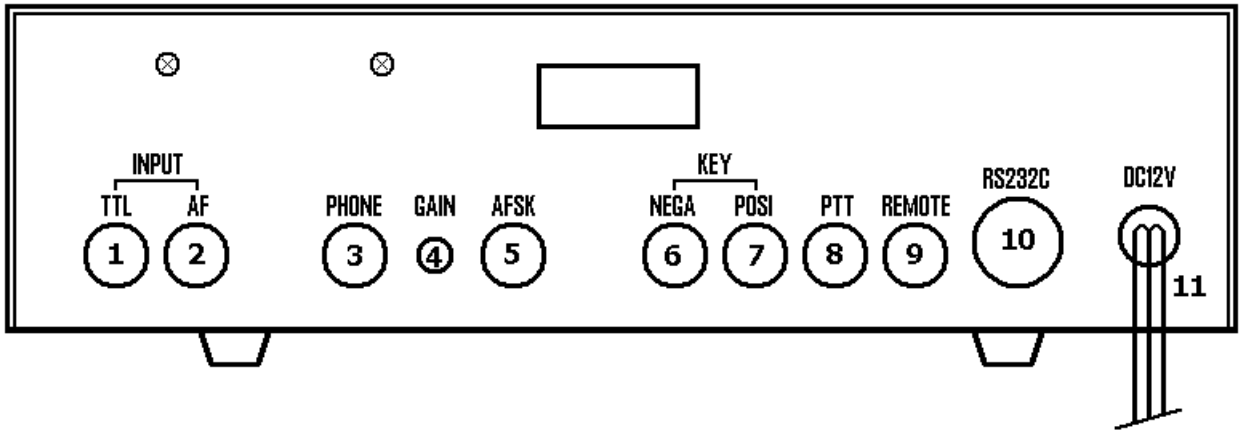
*__Note:__ The data sent from the terminal is stored in the input buffer of the Θ-777. The BUF.FUL LED illuminates to inform that the input buffer is full of data due to the transmission speed lower than the typing speed. Therefore please understand that the data will not be accepted and fall out from the buffer when

1) the connection of a terminal and the Θ-777 is half duplex,
2) the data is exceeding the maximum 768 characters in pre-loaded buffer status.

In above cases, care should be taken not to type in data exceeding the maximum capacity of the input buffer.

1.2 Rear Apron Connections

This section will introduce you into the rear apron connections on the unit.



(1) INPUT TTL jack: This is an input accepting TTL levels for connection of an external terminal unit or key driving the input of the Θ-777.

(2) INPUT AF jack: This is an audio input from a transceiver, tape recorder, etc.

(3) PHONE jack: to defeat internal speaker and use external speaker or headphones.

(4) GAIN control: adjusts the output level of the AFSK jack.

(5) AFSK jack: This is an audio output from the AFSK generator and may be used to feed a transceiver or tape recorder.

(6) KEY NEGA jack: connected to a keying circuit whose polarity is (+) grounded. Common to CW and RTTY.

(7) KEY POSI jack: connected to a keying circuit whose polarity is minus (–) grounded. Most of current transceivers are connected to this jack. It is necessary to replace the connection cord when you change the operating mode between CW and FSK according to each mode.

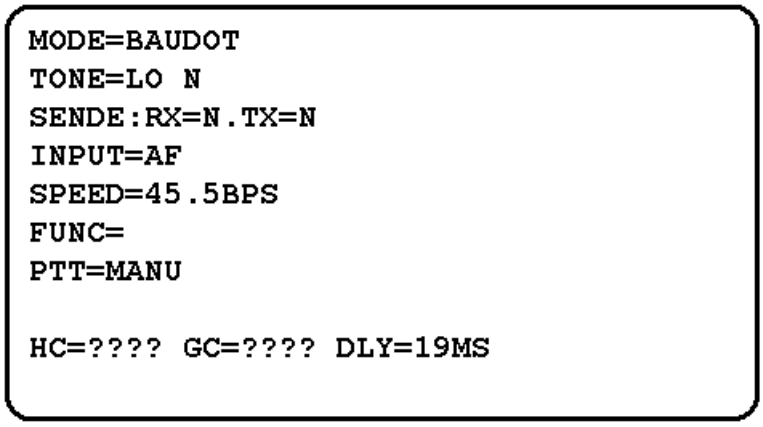
(8) PTT jack: This jack controls the PTT (Push-to-talk) line of the transceiver if desired. It switches on when the unit is in the transmit mode.

(9) REMOTE jack: This is a keying output for use with accessory equipment.

(10) RS232C jack: connected to an ASCII terminal, a Baudot terminal or a computer. The out put of the Θ-777 is RS232C compatible output or TTL level output. The input can be selected by cutting a part of the pattern on the PC board.

(11) DC12V jack: for a DC power source. DC power requirement is 11 to 14 V, 1 A. Connect plus (+) to red, minus (–) to black.

1.3 Screen Indications (Status Lines)



MODE=BAUDOT indicates which communication mode is selected

Indication	Mode	Key commands
ASCII	ASCII	[**ESC**] [**M**] [**1**]
JIS-8	JIS	[**ESC**] [**M**] [**2**]
BAUDOT	BAUDOT	[**ESC**] [**M**] [**3**]
AMTOR	ARQ (AMTOR Mode A)	[**ESC**] [**M**] [**4**]
	FEC (AMTOR Mode B)	
	SEL-FEC (Selective Mode B)	
TOR-L	TOR-Listen (AMTOR Mode L)	[**ESC**] [**M**] [**5**]
BITINV	Bit Inversion	[**ESC**] [**M**] [**6**]
MORSE	Continental Morse	[**ESC**] [**M**] [**7**]
JMORSE	Japanese Morse	[**ESC**] [**M**] [**8**]

TONE=LO N indicates tone and shift width selected. (In Morse Modes, HI for signals over 50 WPM, LO for under 50 WPM.)

HI ..... High Tone (Mark Frequency 2125 Hz)
LO ..... Low Tone (Mark Frequency 1275 Hz)
N ..... Shift Width 170 Hz
M ..... Shift Width 425 Hz
W ..... Shift Width 850 Hz

SENSE:RX=N.TX=N indicates the polarity of send/receive. N is for Normal and R for Reserve.
The keystroke [**ESC**] [**O**] [**1**] reverses the polarity of the receiving. (The same keystroke cancels it.)
The keystroke [**ESC**] [**O**] [**2**] reverses the polarity of the transmitting. (The same keystroke cancels it.)

INPUT=AF indicates which input jack is selected. Press [**ESC**] [**K**] and [**4**], [**5**] or [**6**].

Number	Indication	
4	TTL	TTL level input
5	AF	AF input
6	ANTI	AF input (Anti-noise circuit is activated)

SPEED=45.5BPS indicates communication speed selected.

in Morse	by WPM
in other modes than Morse	by BPS (= bauds)

FUNC= indicates other function in use.

	Function	Key command
E:	Echo Back function	[**ESC**] [**E**]
P:	Pre-load function	[**ESC**] [**P**]
S:	SELCAL function	[**ESC**] [**C**]
U:	Unshift-on-Space function	[**ESC**] [**K**] [**3**]
W:	WRU (Who are you) function	[**ESC**] [**4**]

PTT=MANU indicates switching method for the on/off of PTT, manual or automatic.
The keystroke [**ESC**] [**K**] [**1**] enables automatic on/off of the PTT jack. Press [**ESC**] [**P**] or [**TAB**] to return to manual PTT line keying.

HC=???? GC=???? DLY=19MS (Not applicable in modes other than AMTOR.)

HC= indicates four alphabets for the SELCAL of your own station used in ARQ Mode.

GC= indicates four alphabets for the SELCAL of your own station used in SEL-FEC Mode.

DLY= indicates the delay time in ARQ Mode. Set at 19MS initially.

2. CONNECTIONS

2.1 Connections with Peripheral Equipments

Make sure that each equipment works properly with its power-on status before making any connections.

Power Supply

The POWER switch of the Θ-777 should be OFF before power supply cord is connected. DC power source to be used with the unit should be of 12 VDC with minimum ripple. Red to plus (+), black to minus (–).

Terminal Unit

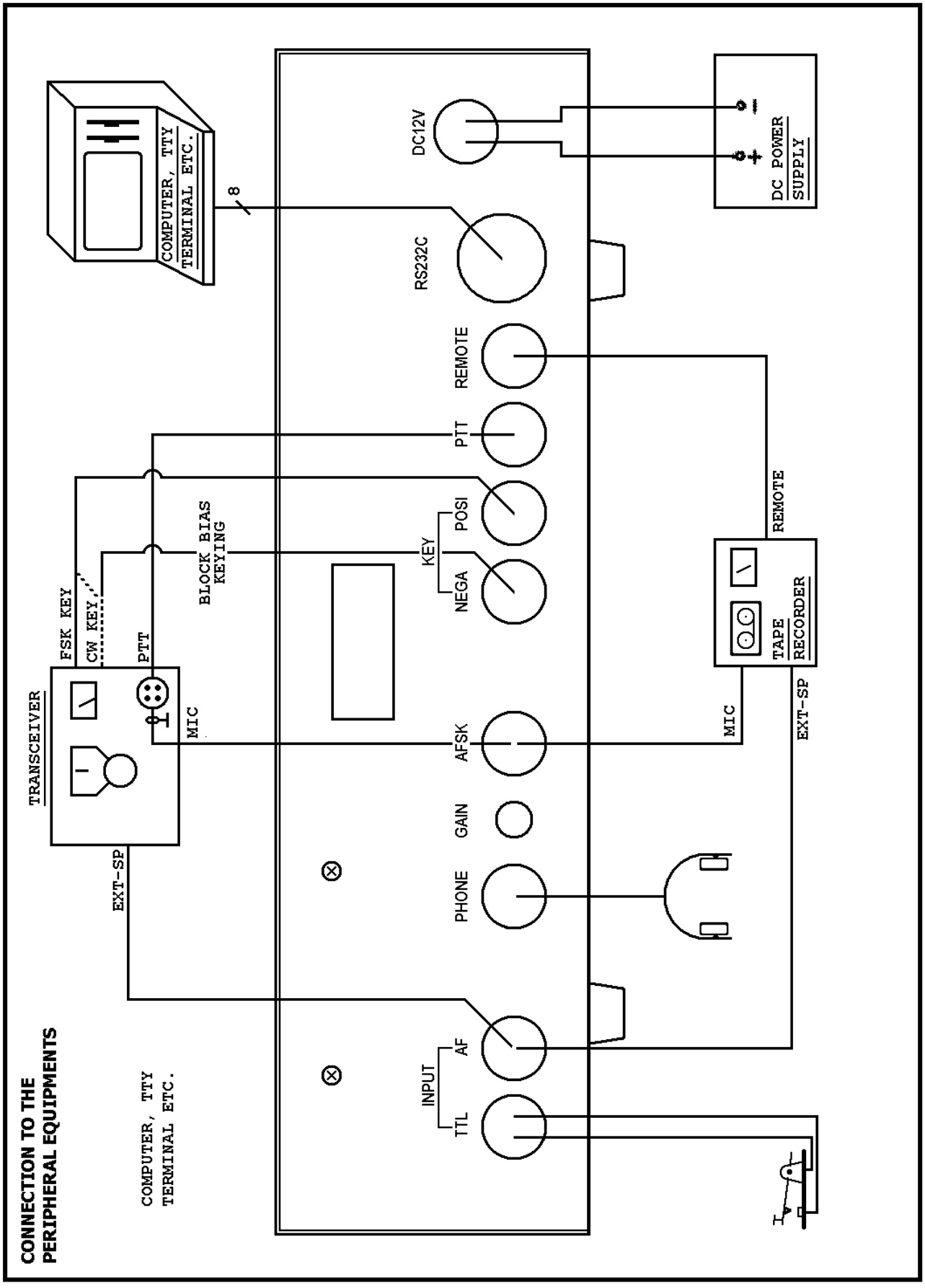
The outputs of the Θ-777 are RS232C compatible output and TTL level output. The input can be selected by cutting a part of the pattern on the PC board. The FAN OUT of TTL level output is three standard-TTL. Be sure to avoid over-load.

Oscilloscope

An oscilloscope ma be used for cross-hatch tuning aid. Carefully remove the upper case of the Θ-777 and connect an oscilloscope to J9 and J10 on the PC board. These terminals have an output impedance of 200 kΩ, 1.5 V_{PP}. An oscilloscope of more than 1 MΩ input impedance may be used with the unit.

Transceiver

The Θ-777 can be connected to most of the transceivers. For the operation of FSK or CW, connect the KEY jack of the Θ-777 with the KEY JACK of the transceiver. Connect the external PTT jack on the rear panel of the Θ-777, then the send/receive switching of the transceiver can be controlled totally from the keyboard. Connect the AF output of the transceiver such as the external speaker jack to the INPUT AF jack of the Θ-777 in every mode. When the FSK function of the transceiver is not used or when using the key jack for CW keying, connect the MIC terminal inside of the MIC jack of the transceiver to AFSK jack of the Θ-777.


CONNECTION TO THE
PERIPHERAL EQUIPMENTS
COMPUTER, TTY
TERMINAL ETC.
INPUT
TTL
AF
PHONE
GAIN
AFSK
KEY
NEGA
POSI
PTT
REMOTE
RS232C
DC12V
8
COMPUTER, TTY
TERMINAL ETC.
DC POWER
SUPPLY
TRANSCEIVER
FSK KEY
CW KEY
PTT
MIC
EXT-SP
BLOCK BIAS
KEYING
REMOTE
TAPE
RECORDER
MIC
EXT-SP

2.2 Connections with a Terminal

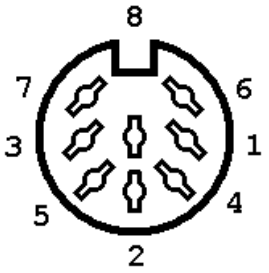
As mentioned in the previous section, the Θ-777 is to be operated with connection to an ASCII terminal or a Baudot terminal which has a serial input/output.

Following equipments which provide RS323C compatible input/output are available as an ASCII terminal, computer, CRT terminal, usual Theta-series units, etc.

A radio teletypewriter, etc. are available as a Baudot terminal.

1) RS232C Level Input/Output

Connection to an ASCII Terminal



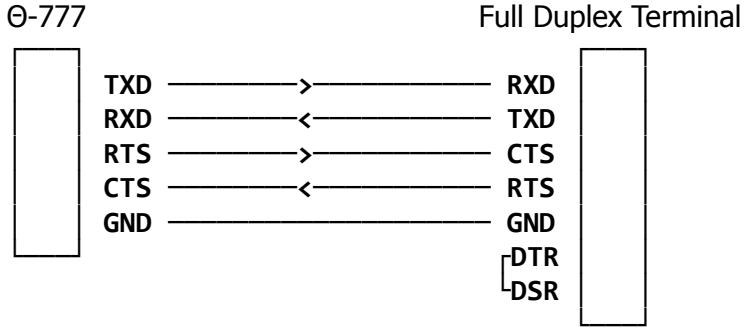
VIEW FROM THE SIDE WHICH
A CABLE IS SOLDERED

1. TTL RTS
2. TTL TXD
3. +5 V
4. CTS
5. RXD
6. RTS
7. TXD
8. GND

The RS232 socket for the computer side of the cable is not included in the accessories, so please prepare a socket suitable for your computer. Refer to the instruction manual of the computer as well as this manual to avoid any problems caused by mistakes in the connections.

Full Duplex

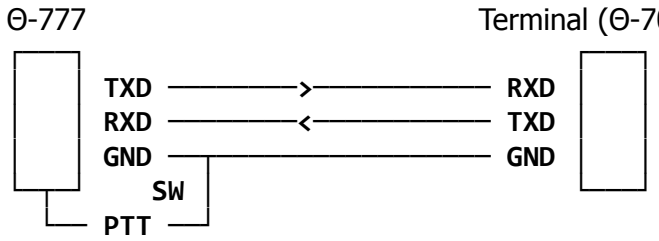
Use full duplex mode if available with the terminal.



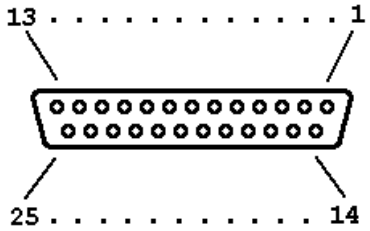
DTR and DSR on the terminal side should be shorted.

Half Duplex

In order to avoid data falling out, install a switch to the cts line and set the input of the Θ-777 on TTL level. Note that data may fall out on the terminal side when RS232C level input is selected.



RS232C Pin Arrangement



VIEW FROM THE SIDE WHICH SOLDERING SHOULD BE MADE

See the above figure for the pin arrangement of the standard RS232C interface in the manual of each computer.

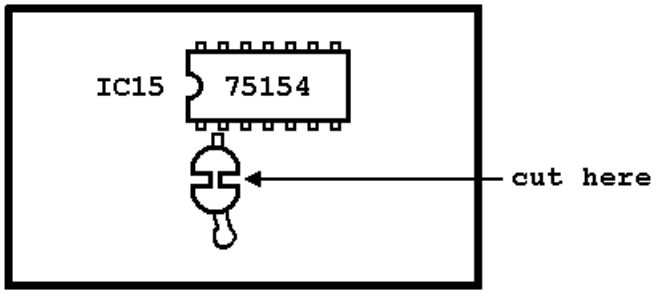
Generally the D-SUB (DB-25) connector of 25-pin is used to connect with RS232C interface of a computer

1	FG	Ground of the body - to GND of Θ-777 -
2	TXD	TX signal line
3	RXD	RX signal line
4	RTS	Send request for transmission
5	CTS	Checks if the companion unit can receive signal
6	DSR	
7	SG	
8	DCD	
9	NC	
10	NC	
11	GND	
12	NC	
13	GND	
14	GND	
15	TXC (2)	
16	NC	
17	RXC	
18	NC	
19	NC	
20	DTR	Informs of the unit to be working to the companion unit
21	NC	
22	NC	
23		
24	TXC (1)	
25	NC	

2) TTL Level Input/Output

The input/output of some terminals is on TTL level. And when a terminal is operated by half duplex, set the input of the Θ-777 on TTL level.

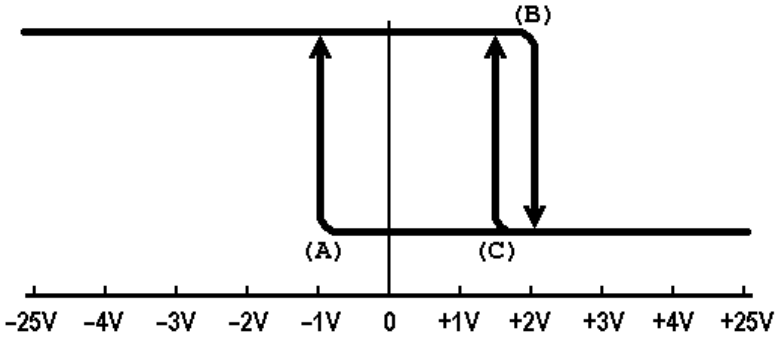
In order to select TTL level input for the Θ-777, cut the pattern located near 2P of IC15 (75154) on the CPU board. When the pattern is closed, the threshold level is –1 V to +2 V and the RS232C level signal is decoded with less noise influence than TTL level. When the pattern is open, the threshold level is +1.5 V to 2 V and the unit decodes both TTL level signal and RS232C level signal. In this case noise influence will be larger.



The output line should be connected to TTL RTS and TTL TXD instead of RTS and TXC respectively.

Threshold Level according to Pattern Cut

The threshold level is a boundary to make judgement of a signal whether at H level (Space) or at L level (Mark). A signal is changed its level from H level to L level or from L level to H level when exceeds the boundary. When the voltage of a signal stays within the boundary, the signal remains to be at the same level as it was.



The threshold level after cutting pattern is shown by a boundary surrounded by line (B) and (C). The threshold level before cutting pattern is shown by boundary surrounded by line (A) and (B).

It is necessary to cut the pattern when TTL level input is selected in order to change the threshold level for the judgement of H/L level (Mark/Space) of a signal.

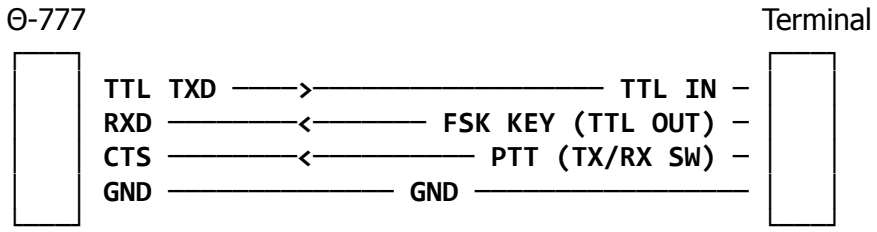
Before cutting the pattern, the threshold level is around –1 V to +2 V so a TTL level signal of +5 V to 0 V cannot exceed the lower line of the boundary. On the other hand, an RS232C level signal of +12 V to –12 V exceeds the lower/upper line of the boundary so that the judgement of H/L level of a signal can be made.

After cutting the pattern, the threshold level becomes +1.5 V to +2 V, and both of RS232C level signal and TTL level signal can be judged whether at H level or L level.

Connection to a Baudot Terminal

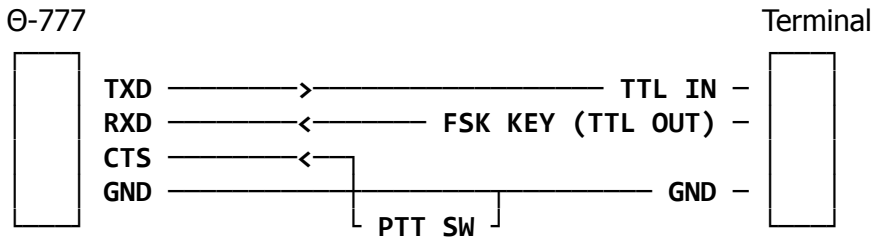
Make connection using the accessory DIN plug as in the figure below. Prepare a plug for the terminal side according to each unit. Refer to the figure in the 'Connection to an ASCII terminal' section and the figures below for the wiring of the DIN plug.

Terminal with PTT switch



Note: Refer to 'TTL level input' in 'Connection to an ASCII terminal' section as the input should be set on TTL level. Cut the pattern around pin #2 of IC15.

Terminal without PTT switch



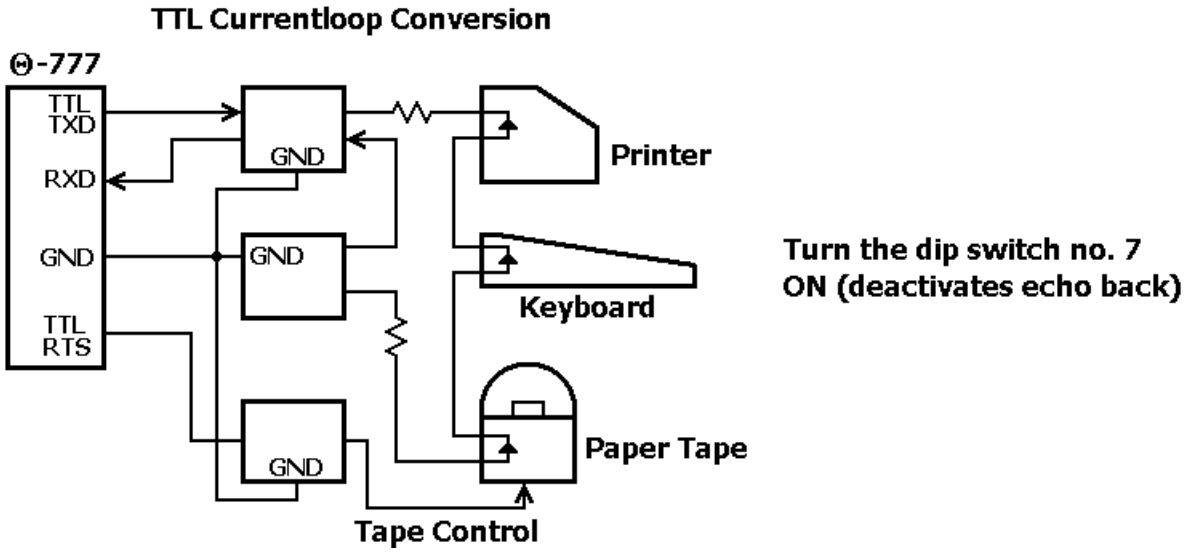
Note: When checking of PTT is not necessary, leave CTS line disconnected. Without the switch, the terminal cannot receive data while transmitting so the data will fall out while in this state. (The Θ-777 continues transmission.)

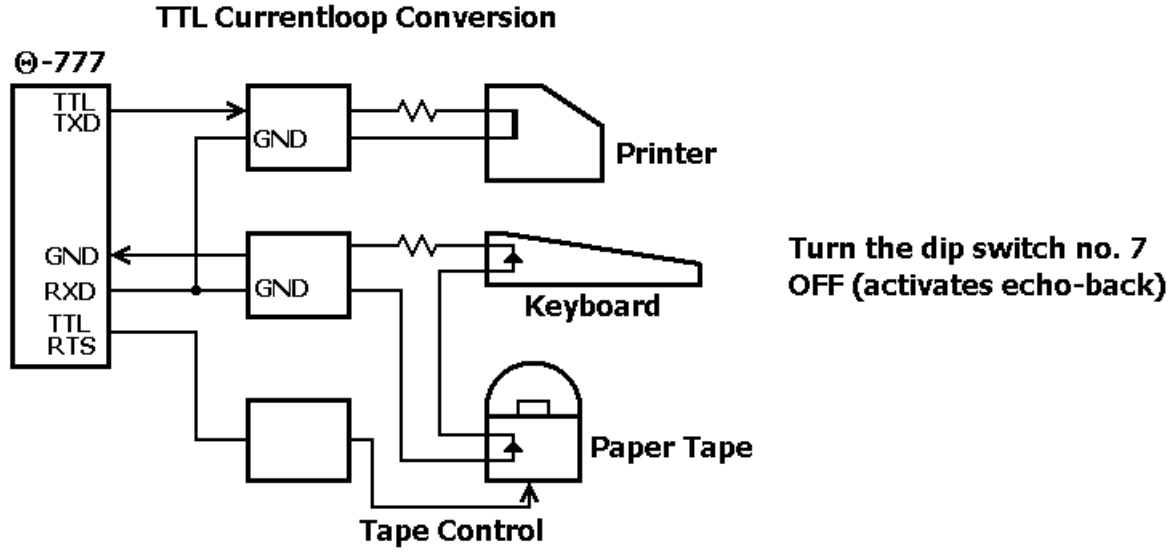
In either of two cases, turn the dip switch no. 7 to OFF (activates echo-back). In echo-back state, data returns to the terminal when PTT switch is turned off (open).

When the PTT switch is on (closed), the output from the Θ-777 to the terminal (TTL TXD) is interrupted.

When you use a Baudot terminal, press the "BLANK" key where [ESC] is indicated in order to output 'BLANK' code as the 'ESC' code is not available with the Baudot terminal.

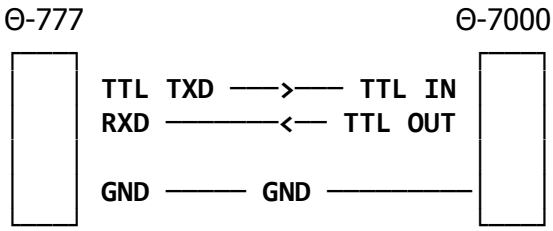
Connect a Baudot terminal as in the figure below. For simultaneous send/receive between the terminal and the Θ-777, connect as shown in lower figure.





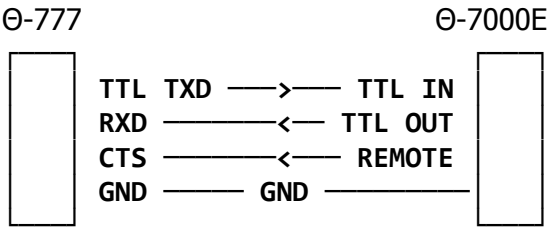
3) Connection to the Theta-series units

The Θ-7000 and the Θ-7000E should be used as ASCII terminal. Make connections as in the figure below:



Dip Switch
No. 7 - off (ECHO ON)
No. 8 - on (HALF DUP)

DISPLAY=RX



Dip Switch
No. 7 - on (ECHO OFF)
No. 8 - off (FUL DUP)

PTT=AUTO

Communication mode should be ASCII. Set the dip switches of the Θ-777 according to the terminal. (The switch no. 7 should be set to off.) Cut the pattern near IC15.

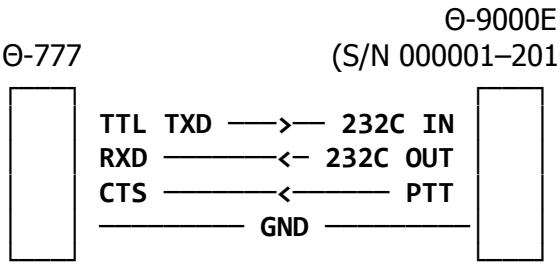
These connections are for half duplex mode. Note that operation of Japanese Morse and JIS Modes are not available using the Θ-7000 or the Θ-7000E.

In case of using the Θ-7000, it would be convenient for operation if the display switch of the Θ-7000 is set to RCV.

In case of using the Θ-7000E, it is suggested to set the unit in automatic PTT switching status.

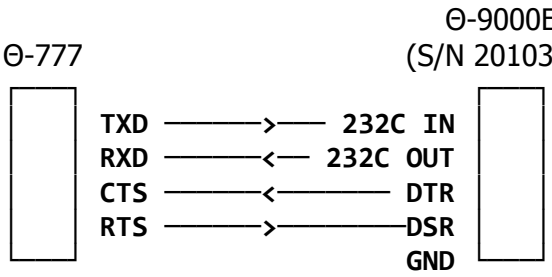
As the [**TAB**] key is not equipped with the Θ-7000 or the Θ-7000E, press [**ESC**] [**D**] instead of [**TAB**] for ending transmission in AMTOR Modes and so on.

The Θ-9000E can be used as a Baudot terminal or an ASCII terminal, however, it is suggested to be used as an ASCII terminal. The full duplex mode is available with the Θ-9000E of serial number greater than 901030 like the RS232C full duplex communication with the computers. Connection should be made as in the following figures according to the serial number of each unit.



Dip Switch
No. 7 - on (ECHO OFF)
No. 8 - off (FUL DUP)

INPUT=232



Dip Switch
No. 7 - off (ECHO ON)
No. 8 - off (FUL DUP)

INPUT=232

'ESC' (escape) code output

The 'ESC' code is transmitted from the Theta-series units with the following key commands:

Θ-9000E (S/N 900001–901029)	[**ESC**] or [**CTRL-1**] or [**CTRL-[**]
Θ-9000E (S/N 901030 – up)	[**CTRL-ESC**] or [**CTRL-[**]
Θ-7000E	[**ESC**]

4) Communication between a Computer and the Θ-777

In order to connect the Θ-777 to a computer with RS232C serial interface, it is necessary to set the both unit at the same communication speed- The Θ-777 can operate at 100 to 2400 bauds. Set the speed according to the specifications of the computer.

Each parameter is to be set as follows:

parity bit = none
bit construction = 8 data bits \ / 7 data bits
or
stop bit = 1 bit / \ 2 stop bits
communication mode = full duplex or half duplex (full duplex is recommended)

There are two ways to send/receive between the two units; one is to operate the computer as a terminal, the other is to control it by software.

Set the communication speed, parity bit, bit construction, stop bit and communication mode as explained above prior to the operation.

To operate the computer as a terminal, set the computer in terminal mode by inputting commands as the following examples:

Model		Command
NEC	PC9801 PC8801	TERM"COM:N81",F
FUJITSU	FM-7 FM-8	TERM"S8N1FN"

To activate the communication between the computer and the Θ-777 controlled by software, input the program as follows according to the computer:

An example of program for controlling NEC PC9801 and PC8801 by software

Code	Remarks
10 ON COM GOSUB 80 20 OPEN "COM:N81" AS #1 30 COM ON 40 A$=INKEY$ 50 If A$="" THEN 40 60 GOSUB 120 70 GOTO 40 80 IF EOF(1) THEN RETURN 90 B$=INPUT$ (LOC(!)),#1 100 PRINT B$; 110 RETURN 120 PRINT #1, A$; 130 RETURN	Starting address for interruption Opens the communication file for RS232 (no parity bits, 8 data bits, 1 stop bit)] Reads key instruction]] Reception interrupting routine] For transmission

5) Setting of the Dip Switches

Before starting operation, set the dip switches on the PC board of the Θ-777 in order to send/receive between either an ASCII terminal or a Baudot terminal and the Θ-777.

	ON	OFF	
SW 1 SW 2	TXD NOR RXD NOR	TXD REV RXD REV	Switches the polarity of TXD. Switches the polarity of RXD.
SW 3 SW 4 SW 5	For setting communication speed - refer to the table below.		Selects the communication speed by the combination of switches 3, 4 and 5.
SW 6 SW 7 SW 8	BAUDOT ECHO OFF HALF DUP	ASCII ECHO ON FUL DUP	Selects the code. Activates/disactivates the Echo-back function. Selects the mode.

Note: The underlined are factory settings.

Baudot	ASCII	SW 5	SW 4	SW 3
45.45 Bd	100 Bd	OFF	OFF	OFF
50 Bd	110 Bd	OFF	OFF	ON
56.88 Bd	150 Bd	OFF	ON	OFF
74.2 Bd	200 Bd	OFF	ON	ON
100 Bd	300 Bd	ON	OFF	OFF
110 Bd	600 Bd	ON	OFF	ON
150 Bd	1200 Bd	ON	ON	OFF
200 Bd	2400 Bd	ON	ON	ON

Note: The underlined are factory settings.

6) Confirmation of Settings

Confirm your connections and settings by the following procedure:

a. Press [**ESC**] [**?**].

Are the initial screen indications as in page 6 displayed?

NO ▼

YES ▼

The connections and the settings are correct. The input/output of each unit is communicated correctly.

b. Press RESET key.

Are the initial screen indications as in page 6 displayed?

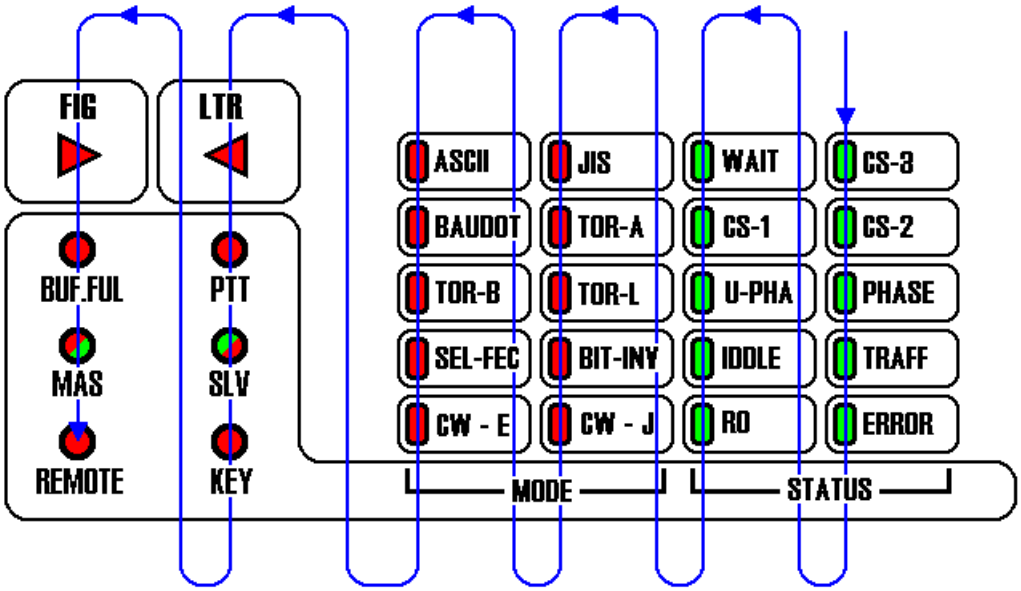
NO ▼

YES ▼

The output from the Θ-777 to the terminal is correct. Check the connection from the terminal to the Θ-777.

The connection of both of the input and/or output may be incorrect. Check again the procedure of the connections and settings.

When the setting of SW 2 of the dip switches is not corresponding to the incoming signal (which means that the setting on polarity is incorrect), LEDs on the front panel illuminate in order from the top to the bottom of the five right-most LEDs to the left-most as shown by the figure below.



c. If random characters or figures are displayed, the communication speed or the polarity may not be agreed.

Set the dip switches of the Θ-777 according to the specifications of the terminal.

---

3. OPERATION

When you use a Baudot terminal, press the "BLANK" key where [ESC] is indicated in order to output 'BLANK' code as the 'ESC' code is not available with the Baudot terminal.

3.1 CW (Continental Morse) Mode

To select the Continental CW Mode, press [**ESC**] [**M**] [**7**] one after another.

Receiving

Practice tuning using VFO (RIT) of the transceiver to the point where the maximum amplitude of the mark LED is achieved. The Θ-777 automatically tracks the speed and starts decoding when properly tuned. Set the unit at high tone by the keystrokes [**ESC**] [**T**] and [**4**], [**5**] or [**6**] for AUTOTRACK of higher speeds (above 50 WPM). For lower speeds, the unit should be set at low tone by the keystroke [**ESC**] [**T**] [**1**], [**2**] or [**3**]. Usually the unit may be operated at lower speeds with the setting for low tone. In case signals of lower speeds are received with the settings for high tone the unit tracks the signal, however, may become weak against noises.

Anti-noise Feature

Press [**ESC**] [**K**] [**6**] if noise causes unwanted random-character reception with no existing signals.

Input Selection

To select TTL IN terminal for an electric keyer or other TTL level input, press [**ESC**] [**K**] [**4**]. The keystrokes [**ESC**] [**K**] [**5**] select AF IN terminal for audio signal input from a transceiver, tape recorder or other audio device.

Transmission

Automatic/Manual PTT (push-to-talk) line keying

Press [**ESC**] [**K**] [**1**] to select automatic PTT line keying. The PTT line is keyed whenever there are characters to transmit. [**ESC**] [**D**] or [**TAB**] unkeys the PTT line.

Another keystroke of [**ESC**] [**K**] [**1**] returns the unit to manual PTT operation. The PTT line is keyed/unkeyed by the keyboard instruction [**ESC**] [**D**] or [**TAB**].

Weight Setting (Dot to Dash Ratio)

Weight is adjustable in the range of 1:3 to 1:7. Press [**ESC**] [**W**] followed by the keystroke of the desired number (0 through 9).

Speed Setting

On receiving the Θ-777 autotracks in the range of 5 – 100 WPM (word/minute). On transmitting the speed is set by number of words per minute. Any speed down to one decimal place can be entered in the range of 5 – 100 WPM.

eg. 9 WPM = [**ESC**] + [**S**] + [**9**] + [**.**] + [**0**]
63.5 WPM = [**ESC**] + [**S**] + [**6**] + [**3**] + [**.**] + [**5**]
100 WPM = [**ESC**] + [**S**] + [**1**] + [**0**] + [**0**]

NOTE: 100 WPM is the maximum CW speed that the Θ-777 can offer. Any possible screen indication of over 100 WPM does not indicate an actual speed in use.

Your desired communication speed is programmed by [**ESC**] [**S**] [**R**] which should be pressed after setting the speed as explained above.

Special Characters

Upon any of the following special characters the Θ-777 sends CR/LF information to the connected computer.

Special Character	Screen display
$\overline{\text{KN}}$	(
$\overline{\text{AR}}$	+
$\overline{\text{VA}}$	*

3.2 CW (Japanese Morse) Mode

The keystroke [**ESC**] [**M**] [**8**] selects the Japanese CW Mode which is initially set to print English characters.

To select Japanese kana characters for the contact, press [**ESC**] [**1**] to transmit ¿¿. Japanese kana characters are also selected on reception of ¿¿ code.

The output of $\overline{\text{BT}}$ by pressing [**ESC**] [**2**] or receiving $\overline{\text{BT}}$ code returns the unit to print English characters.

When receiving, the keyboard instruction [**ESC**] [**X**] enables manual switching of the English/kana characters.

Judging of $\overline{\text{BT}}$ and ¿

When '**–···–**' code is received in Japanese CW Mode, the unit cannot judge which signal of $\overline{\text{BT}}$ or ¿ is sent since both two signals correspond to the code.

With the keystroke [**ESC**] [**K**] [**3**], the unit judges the code to be ¿ and locks in printing Japanese kana characters. The indication on the screen will be **FUNC=U**. So give the instruction previously in order to keep your contact in Japanese kana characters. With another keystroke of [**ESC**] [**K**] [**3**], the unit judges the code to be BT and changes to print English characters. The indication will be just **FUNC=**.

3.3 Baudot Mode

Connection should be made between the RTTY or FSK terminal of the transceiver and FSK jack of the Θ-777. In the absence of RTTY or FSK Modes, use LSB (AFSK) and connect microphone terminal to the AFSK jack of the Θ-777.

Press [**ESC**] [**M**] [**3**] to initialize the Baudot Mode.

Mark/Space Tone and Shift Width

The keystroke [**ESC**] [**T**] and a number [**1**] trough [**6**] selects shift width and tones.

Number	Indication	Mark Freq.	Space Freq.	Tone, Shift Width
1	TONE=LO N	1275 Hz	1445 Hz	Low Tone, 170 Hz
2	TONE=LO M	1275 Hz	1700 Hz	Low Tone, 425 Hz
3	TONE=LO W	1275 Hz	2125 Hz	Low Tone, 850 Hz
4	TONE=HI N	2125 Hz	2295 Hz	High Tone, 170 Hz
5	TONE=HI M	2125 Hz	2550 Hz	High Tone, 425 Hz
6	TONE=HI W	2125 Hz	2975 Hz	High Tone, 850 Hz

Reverse/Normalize the Polarity of TX/RX Signals

Polarity of TX/RX signals is switchable by the keyboard by the keyboard instruction.

Transmission	Press [**ESC**] [**O**] [**2**]	*1
Reception	Press [**ESC**] [**O**] [**1**]	

Input Jack Selection

Press [**ESC**] [**K**] [**4**], [**5**] or [**6**] to select input jack.

Number	Indication	
4	TTL	TTL level input
5	AF	AF input
6	ANTI	AF input (Anti-noise circuit is activated)

Automatic/Manual PTT (push to talk) line keying

Press [**ESC**] [**K**] [**1**] to select automatic PTT line keying. The PTT line is keyed whenever there are characters to transmit. [**ESC**] [**D**] or [**TAB**] unkeys the PTT line.

Another keystroke of [**ESC**] [**K**] [**1**] returns the unit to manual PTT operation. The PTT line is keyed/unkeyed by the keyboard instruction [**ESC**] [**D**] or [**TAB**].

Character Setting

The alternate "letters" or "figures" character set is selectable by the keystroke [**ESC**] [**X**].

Automatic CR/LF Insertion

CR/LF is automatically inserted by the keyboard instruction.

No automatic CR/LF insertion	Press [**ESC**] [**L**] [**0**]	
64 characters after last CR/LF	Press [**ESC**] [**L**] [**1**]	
72 characters after last CR/LF	Press [**ESC**] [**L**] [**2**]	*2
80 characters after last CR/LF	Press [**ESC**] [**L**] [**3**]	

Speed Setting

Speed may be set as desired in the range of 12–600 bauds. 45.5, 50, 56.9, 74.2, 100, 110, 150, 300 and 600 bauds are most commonly used. Among those rates, 45.5 bauds is most commonly used in amateur bands, and 50 bauds is common in commercial use. Three significant figures including decimal place may be entered, such as:

100 bauds =	[**ESC**] + [**S**] + [**1**] + [**0**] + [**0**]	
45.5 bauds =	[**ESC**] + [**S**] + [**4**] + [**5**] + [**.**] + [**5**]	
50 bauds =	[**ESC**] + [**S**] + [**5**] + [**0**] + [**.**] + [**0**]	*3

Your desired communication speed is programmed by [**ESC**] [**S**] [**R**] which should be pressed after setting the speed as explained above.

Diddle Feature

The "LETTERS" shift character will be transmitted while the keyboard is idle in order to keep the receiver in synchronization or to keep the threshold level of the ATC circuit in the demodulator at a fixed level. Press [**ESC**] [**/**] to activate the function.

Unshift-on-Space (U.S.O.S)

This function causes the unit to return to the "LETTERS" mode upon receipt of a space character. It is very useful when noise causes case errors. The feature turns by the keystroke [**ESC**] [**K**] [**3**]. On the screen **FUN=U** is displayed.

CW ID

The keystroke [**ESC**] [**I**] transmits CW identification. The identification code should be previously written in Channel #E. The transmitting sped will be as programmed in the CW Mode by the keystrokes [**ESC**] [**S**] [**R**].

*1 NOTE: Some transceivers have different polarity setting of FSK TX signals than others.

Examples:	TRIO-KENWOOD transceivers:	reverse polarity
	ICOM, YAESU transceivers:	normalize polarity

*2 NOTE: The initial setting; when power is turned on or the RESET key is pressed.

*3 NOTE: [**0**] must be entered after the decimal point when a two-figure speed is set.

Receiving Operation

1. Place your transceiver in the RTTY Mode (for most transceivers, this is LSB).

2. Practice tuning using VFO (RIT) of the transceiver from lower level to the second point where the mark LED illuminates.

3. Tune using SHIFT control to the point where the maximum amplitude of the space LED is achieved.

4. If a meaningful screen display is not achieved when both mark and space LEDs illuminate, try changing the polarity. If this does not work, speed adjustment is needed. Any signals that cannot be received successfully with any speed/polarity are probably encoded.

3.4 ASCII (RTTY) Mode

Press [**ESC**] [**M**] [**1**] to initialize the ASCII Mode. Operational procedures and functions are the same as in Baudot Mode.

3.5 JIS (RTTY) Mode

Press [**ESC**] [**M**] [**2**] to initialize the RTTY (JIS) Mode. Operational procedures and functions are the same as in Baudot Mode.

In the JIS Mode, alphabet/kana characters are printed according to the input from the computer.

3.6 Bit Inversion Mode

Press [**ESC**] [**M**] [**6**] to select the Bit Inversion Mode. This mode is a term of communication in cipher based on Baudot code and should not be used among amateurs.

The signals are ciphered by reversing the polarity of bit/bits of five-bit-Baudot code voluntarily. The data of contact can be kept from anybody except who is agreed on the combination of inversion in advance.

The combination of inversion is specified by the keyboard instruction [**ESC**] [**G**] and a five-number-combination made up of 0 and/or 1. The keystroke [**1**] reverses the polarity and [**0**] leaves it as in normal polarity. Each number corresponds to bit 40 from the first number to the last. The five right-most LEDs of twenty mode/status LEDs indicate which bit/bits are reversed by illuminating where [**1**] is entered. Each LED signifies bit 4-0 from the top respectively.

Both your station and a distant station should set the agreed combination prior to a contact.

Example: To reverse the polarity of the bit 4 and bit 1, press
[**ESC**] + [**G**] + [**1**] + [**0**] + [**0**] + [**1**] + [**0**]
then the first and the forth LEDs from the top will illuminate.

The combination of '00000' represents the standard Baudot-RTTY, and the polarity of all bits are reversed when '11111' is keyed in.

Considering the five-number-combination as a numerical value in binary notation, you can increase the value by one with the keystroke [**ESC**] [**G**] [**2**]. Therefore when no bit is reversed, first keystroke of [**ESC**] [**G**] [**2**] increases the value from '00000' to '00001' and the second one increases it to '00010'. The LED indication on the unit will change accordingly.

Example: When '10011', [**ESC**] [**G**] [**2**] increases it to '10100'.
When '01111', [**ESC**] [**G**] [**2**] increases it to '10000'.

Operational procedure and functions are the same as in Baudot Mode.

---

4. DATA TRANSMISSION

When you use a Baudot terminal, press the "BLANK" key where [ESC] is indicated in order to output 'BLANK' code as the 'ESC' code is not available with the Baudot terminal.

Preload Buffer Transmission

The Θ-777 has a 768-character input buffer memory.

Enter [ESC] [P] to preload data in the buffer. **FUNC=P** will be indicated on the screen. Data entered from the keyboard will be loaded in the buffer, which can be visually checked on the screen. Another [ESC] [P] transmits the data and deactivates the feature upon completion of the transmission. The transmission may be halted by the keystroke [ESC] [P]. If you wish to transmit the rest of the data after the halt, enter another [ESC] [P]. The buffer is cleared when [CTRL-X] or [ESC] [CR] is entered. [DEL] is effective for error correction, as long as the error is still in the buffer, prior to transmission.

Preloading status entry	[**ESC**] [**P**]
To transmit preloaded data	[**ESC**] [**P**]
To halt transmission	[**ESC**] [**P**]
To continue transmission after halt	[**ESC**] [**P**]
To clear the buffer	[**CTRL-X**] or [**ESC**] [**CR**]
Error correction	[**DEL**] or [**ESC**] [**Z**]

Channel Memory Transmission

The Θ-777 has 15 channels of message memory. The allocation is:

Channel #1, 2, 3, 4	64 characters
Channel #5, 6, 7, 8, 9, 0	32 characters
Channel #A, B, C, D	16 characters (for SELCAL data)
Channel #E	32 characters (for CW ID, SELCAL Answer-back, QBF test message, 'Here Is' Message, etc.)

Note: Please understand that these channel memories are not backed up by batteries so the messages are cleared when power is turned off!

1. Programming

Press [**ESC**] [**J**] and then enter a number or letter from the keyboard to select a channel. Enter message and press [**ESC**] at the end.

Programming	[**ESC**] [**J**] + {channel} + {message} + [**ESC**]
Error Correction	[**DEL**]

2. Transmission

Press [**ESC**] [**R**], then the desired channel number (letter) and then the number of times of transmission.

[**ESC**] [**R**] + {channel} + number of times to be transmitted

Note: Programming is not possible during channel transmission.

Echo Back Transmission

The Θ-777 can receive and simultaneously retransmit data from an external device. The input should be either AF (eg. signals recorded on cassette tape) or TTL level (eg. electric keyer signals).

To select input terminal, press [**ESC**] [**4**] for TTL level or press [**ESC**] [**5**] for AF.

The keystroke [**ESC**] [**E**] activates/deactivates the feature. **FUNC=E** will be indicated on the screen.

Note: This feature is not available in the AMTOR Mode.

Test Messages

[**ESC**] [**Q**]	QBF	THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG 1234567890 DE {data memorized in Channel #E}
[**ESC**] [**Y**]	RY	RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRY.....
[**ESC**] [**U**]	CW	random feature for CW practice

Any keystroke will stop the QBF, RY or CW random signals.

5. SPECIAL FEATURES

SELCAL (Selective Calling) System

This is a system for receiving certain calls selectively among many other incoming calls. With this system, the Θ-777 decodes calls only when they accompany a set of signals previously agreed upon. In other words, all the calls at a frequency will be ignored except the ones with "password" (SELCAL) signals.

Two SELCALs are required for a station: one open and another to close a contact. It is prerequisite for the system to store the SELCALs in channel memory.

Note: The SELCAL feature described here is not available in the AMTOR Mode. In AMTOR, a different form of SELCAL is used.

1. SELCAL programming

Channel A	Opening SELCAL of other station
B	Closing SELCAL of other station
C	Opening SELCAL of your station
D	Closing SELCAL of your station
E	Answerback

Follow the procedure of programming in channel memories.

Note: The code for opening SELCAL of your station must be different from the Answerback code.

2. The keystroke [**ESC**] [**C**] activates the SELCAL feature. (The screen indication is **FUNC=S**.) Any data entered from the keyboard will be written in the buffer and may be sent.

3. Upon receipt of the proper SELCAL, the Θ-777 starts decoding and keys the REMOTE line for external equipment such as a tape recorder. Upon receipt of the closing SELCAL it unkeys the REMOTE line, keys the PTT line temporarily to send Answerback.

4. Another [**ESC**] [**C**] deactivates the feature.

'WRU' (**W**ho a**R**e yo**U**) Feature

The Θ-777 provides 'Who aRe yoU' control code. This feature is available also in AMTOR Modes and allows a sending station to confirm the identity of the receiving station of this code. The keystroke [**$**] transmits 'WRU' control code.

On receiving the WRU code, the unit sends back 'HERE IS' message in the following procedure:

In Baudot and Bit Inversion Modes	A few seconds after receiving the code, the unit unkeys the PTT line and sends 'HERE IS' message and then automatically keys the PTT line.
In ARQ Mode	Reception of the WRU code enables the unit to send back transmitting/receiving changeover code and then 'HERE IS' message and a second change over code followingly. Both ISS and IRS simply press [$] to transmit WRU code and thy automatically returns original ISS/IRS role after giving HERE IS message.

In FEC and SEL-FEC Modes	When receiving the WRU code, the unit confirms that the sending station comes to be in a receiving state. After the confirmation, the unit unkeys the PTT line and sends the HERE IS message and then keys the PTT line to return to the receiving state.

'HERE IS' message usually consists of HERE IS and your call sign. You are requested to program the message in channel E before the operation. The keyboard instruction for programming is [**ESC**] [**J**] [**E**] + message (your call sign) + [**ESC**].

In case using the WRU feature with a Baudot terminal, WRU control code corresponds to 'FIGS D' and is decoded as '$'. It may be confusing if the sending station intends to send the dollar sign and not request a WRU identification. Therefore, it is recommended to program off the WRU feature unless it is used in your contact. On/off of WRU feature is available by the keystroke [**ESC**] [**4**].

When the WRU feature is activated, **FUNC=W** is displayed on the screen.

> **Note:** When the WRU feature is activated, '$' is not displayed on the screen even when the unit receives 'FIGS D' code. When the feature is deactivated, '$' is displayed on the screen.

Automatic Mode Selection Feature

Upon receipt of RTTY signal (Baudot, ASCII, JIS, Bit inversion), the Θ-777 automatically judges its mode, speed and polarity and starts decoding the signal.

Be sure to tune to the signal so that the maximum amplitude can be obtained for both Mark and Space tones.

Press [**ESC**] [**M**] [**0**]. After certain time, the Θ-777 judges the speed, mode and polarity and displays them on the screen. The indication of mode by LED's on the front panel and by the monitor will be 'ASCII' for ASCII or JIS Mode and 'BAUDOT' for Baudot or Bit Inversion Mode. Decode data will be displayed followingly.

If signals cannot be decoded even when above procedure is repeated several times, the signal may be ciphers or of Bit Inversion Mode, or may not be RTTY signal.

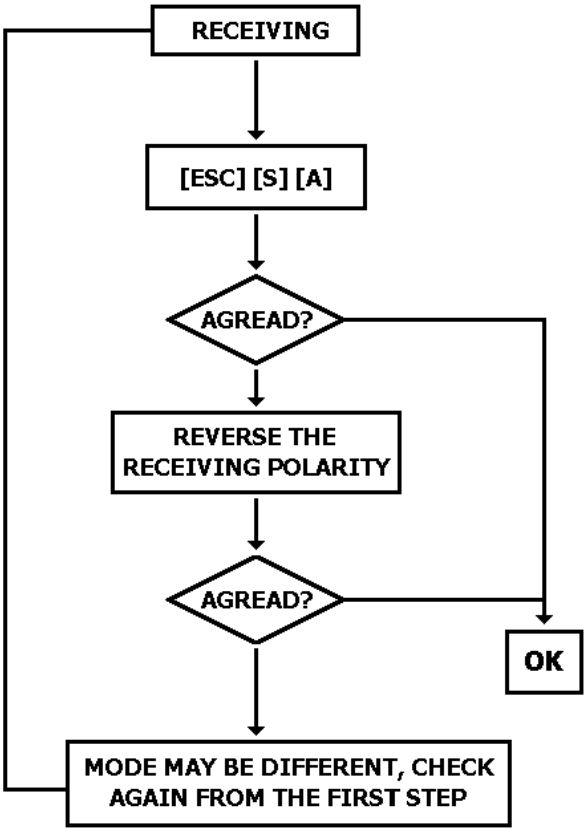
Autotrack of Speed

When Mode is already known, the unit judges speed of a signal alone automatically.

Tune to the signal so that the maximum amplitude is obtained for both Mark and Space tones. Press [**ESC**] [**S**] [**A**]. Upon judgement, the speed is indicated on the screen such as **SPEED=50BPS**.

Noise influence may cause the unit to display speed faster than the actual one. Please repeat the above procedure if necessary.

When either of mode, speed or polarity is not agreeing, the RQ LED on the front of the panel illuminates. in this case, operate as in the figure.



Application of Connection with RS232 Terminal

Utilizing the automatic mode selection feature, not only terminals with keyboard but any terminals which communicate by RS232 level signal can be connection with an RS232C serial printer. The printer only receives data so is exclusive equipment for receiving.

The connection below may be a good example of basic way of connection with similar terminals.

Example

Θ-777		Terminal (RS232 serial printer, etc.)
TXD	———————	RXD
RXD	NC	TXD
CTS		RTS
RTS		CTS
GND	———————	GND

Note: Mode should be set to half duplex.

In order to utilize the cable of the standard connection (full duplex mode) with D-SUB25 socket for this exclusive use of receiving, set the dip switches of the Θ-777 to HALF DUP and IN REV. Refer to page 17. However, as for terminals which operate properly with IN REV state, switch to IN NOR position.

When the polarity (MARK/SPACE) of input signal is reversed, the LEDs on the front panel illuminate in order as shown by the figure on page 18 upon pressing the RESET button and the automatic mode selection is enabled as a mode exclusively for receiving.

6. AMTOR MODE

6.1 Basic Theory

A conventional RTTY signal consists of one start bit, five data bits and one stop bit. A start bit can synchronize the receiver decoding. Each signal can be separated from the following signal by a stop bit. However, there are some problems in this convenient start/stop system. Any noise or other interference which reverses the polarity of the receiving data bit results in misprinting. The start/stop bit can cause errors when mutilated. There is no way to confirm whether or not transmitted signals are decoded correctly by the distant receiver.

The AMTOR system was developed to improve the conventional system. The basic concept of AMTOR is to ensure that an error in the received signal will not cause an error in printing. This is achieved by transmitting extra information together with the data, if any. In this system a character is constructed with seven data bits, instead of five. Four bits are of one polarity (B, High frequency) and the rest are of the other (Y, Low frequency). There are 35 possible combinations of seven bits and 32 of them are translated to the standard RTTY characters. The remaining three combinations are used as special control signals. Any received signal other than 4B3Y ratio is to be processed as an error.

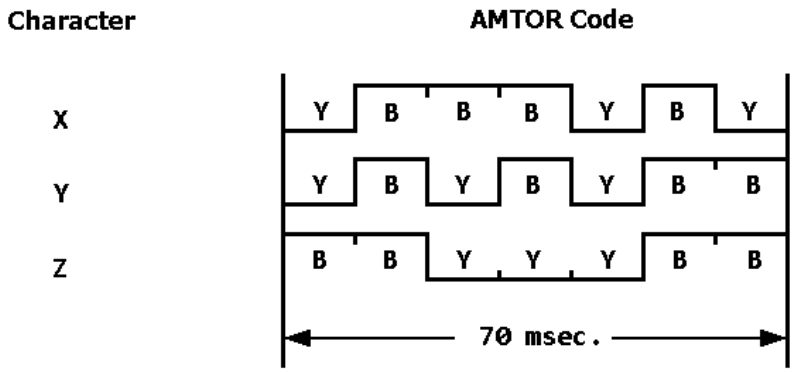
The AMTOR system consists of three different modes. The are: Mode A (ARQ, Automatic Request), Mode B (FEC, Forward Error Correction) and Mode L (Listen to the ARQ contact).

Mode A is used for communication between two specified stations, in conjunction with a special SELCAL system. Mode B is for transmission to a large number of stations. It can be used for broadcast messages such as news or CQ calls. With Mode L one can monitor Mode A (ARQ) communication between to other stations. In Mode A, upon receipt of an error, the receiver automatically requests the transmitter to repeat the same signal till it is decoded correctly. In Mode B, seven-bit characters are transmitted twice and the distant receivers select which of the two is of the 4B3Y ratio. Thus communication with the AMTOR system is considerably more reliable than conventional RTTY communication.

Data Construction

A character consists of seven data bits. Four bits of them are of B (High frequency) and the three are of Y (Low frequency). When any signal other than 4B3Y ratio is received, the receiver automatically requests the sending station to repeat the signal. It takes 70 msec. to transmit a seven-bit character at the speed of 100 bauds.

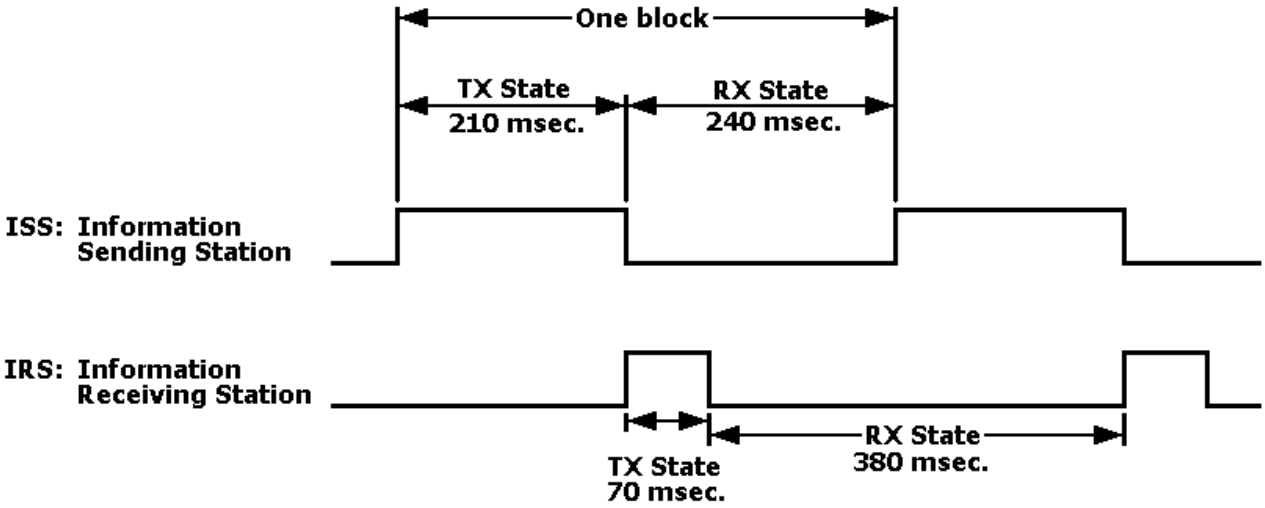
Example of the construction:



The Θ-777 operates AMTOR and RTTY system (the system based on the RTTY system), which works with Y frequency 1275 Hz and 2125 Hz and Shift Width 170 Hz, 425 Hz and 850 Hz which are used in the RTTY Mode.

6.2 Mode A (ARQ, Automatic Request)

In AMTOR Mode A, 450 msec. is considered as one block. During a block a group of three seven-bit characters (210 msec.) is transmitted serially and then the transceiver switches to the receiving state for 240 msec. to receive a seven-bit control signal. The control signal determines next group of three characters to be transmitted.



In case there is any signal detected to be an error, the same block will be transmitted till it is decoded correctly. No error will be printed. Signals are transmitted block by block as shown above.

Some terms should be defines before discussing the operation in detail.

Master Station (MS): The Station that starts the communication. (It does not mean who is ending data at any time, but only who begins the contact.)

Slave Station (SS): The station that is called by the MS.

Information Sending Station (ISS):
The station that is generating or sending data at a given moment. The term "transmitter" may also be used.

Information Receiving Station (IRS):
The station that is receiving and printing data at a given moment. The term "receiver" may also be used.

The relation between the MS and the SS does not change even when the MS becomes IRS and vice versa.

The communication starts when a station (MS) calls the distant station (SS) with its SELCAL. Only the station whose SELCAL corresponds with the one transmitted is able to respond. On receiving its own SELCAL, the SS sends back the control signal. Signals are transmitted in the following procedure:

Example To transmit "TNX FER UR CALL"

The transmitter sends the first three-character block "TNX". The receiver replies with one control signal that says either "Correctly received. Send the next three." or "Missed the group. send it again.".

During pauses in the keyboard typing or when the signal fade out, idle signals are transmitted to maintain synchronization.

In case the signal fades out and nothing is received for more than 32 blocks while the MS is ISS, the MS automatically returns to PHASING state and the SS switches to WAITING state to regain synchronization. Similarly, if the same thing happens while the SS is ISS, the SS switches to WAITING state and the MS returns to PHASING state. As soon as getting synchronized, the SS returns to transmitting state and the MS does to receiving state.

The transmitting/receiving role changes when the ISS sends a changeover code. On receiving it, the IRS takes its turn to be a transmitter.

End of contact is always initiated by the ISS. When the ISS transmits a signal to finish the contact, both ISS and IRS returns to the waiting state.

ARQ Operation

The keyboard instruction of the mode setting is [**ESC**] [**M**] [**4**]. The initial state (waiting status) is common to Mode A, Mode B and SEL-FEC Mode. Following LEDs illuminate simultaneously in the waiting status 'TOR-A', 'TOR-B', 'SEL-FEC' and 'WAIT'.

Before starting a contact, you are suggested to store your own SELCAL. The keyboard instruction is [**ESC**] [**H**] + four letters. To start a contact as a master station, transmit SELCAL of other ARQ station by pressing [**ESC**] [**A**] + four letters. You can start a contact as a slave station after getting synchronized.

LED indication changes to 'TOR-A' and 'PHASE' upon transmission of the SELCAL of other ARQ station, or 'TOR-A' and 'U.PHA' on getting synchronized. 'MAS' (Master) LED illuminates with red when you are ISS and green when you are IRS. 'SLV' (Slave) LED also illuminates with red when you are ISS and green when you are IRS. Refer to '6.7 Introduction to the LED Indicators' for other indications.

IRS's reception of a combination of '+' and '?' changes the transmitting/receiving role. Upon receipt of the combination, IRS becomes ISS and vice versa. This feature is initiated only by ISS.

To return both ISS and IRS to the waiting status, the ISS should give a keystroke [**TAB**] or [**ESC**] [**D**]. The keystroke [**ESC**] [**W**] returns only ISS to the waiting status.

> **Note:** When you use a Baudot terminal, press [BLANK] key instead of [ESC] because the 'ESC' code is not available with the Baudot terminal.

When your station is being called by a distant station in Mode A and can not synchronize with it in spite that:

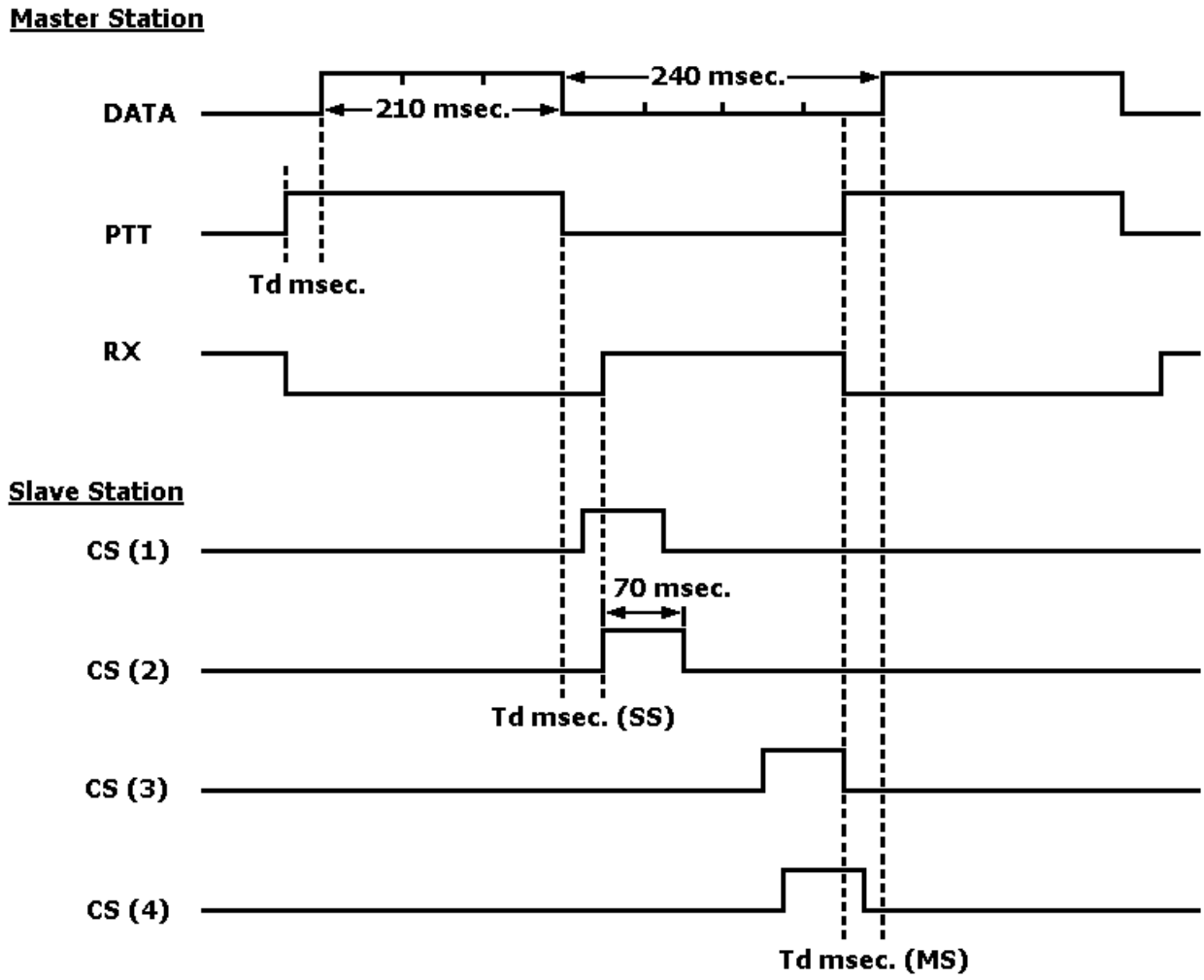
> Your SELCAL is memorized correctly;
> Both Mark and Space LED bargraph meters illuminate;
> Cross-hatch shows proper form.

The polarity of the incoming signal may be reversed. Reverse the polarity of receiving by pressing [**ESC**] [**O**] [**1**] and see if this results in synchronization. When the LED 'U.PHA' illuminates for a while, the polarity of the output signal may be reversed. Reverse the polarity of transmission by pressing [**ESC**] [**O**] [**2**].

Similar problems in Mode B, SEL-FEC Mode or Mode L may be solved in the same manner.

PTT Time Delay

The relation between data (Master station) and CS control signal (Slave station) is as shown below:



In the communication between near two station, it may be possible that CS control signal sent by the slave station is not received perfectly because the CS signal arrives at the master station before it becomes in the RX state as shown in CS (1). Such state may occur because transceivers need certain time for TX/RX changeover. Therefore, the slave station is requested to make the PTT delay time (Td msec.) long enough so that the cs signal may be received perfectly.

In the communication between distant two station, the same thing may happen because CS control signal does not arrive at the master station by the time when PTT line of the station is keyed as shown in CS (4). Therefore the master station is requested to make the PTT delay time (Td msec.) short enough to receive the CS signal perfectly.

The time delay "TD" can be varied by 2 msec.-step from 7 msec. through 43 msec. Td is indicated in the left part of the screen by pressing [**ESC**] [**?**]. With the keystroke [**ESC**] [**V**], Td is decreased by 2 msec.-step. The initial value is set on 19 msec. Set Td in accordance with the time required for TX/RX changeover of your transceiver and the distance between two stations.

Break-In Feature

When IRS has necessity of transmitting message while ISS is still transmitting the data, the changeover if ISS/IRS role will be performed. The keyboard instruction is [**ESC**] [**/**]. Careful attention should be paid to use this function.

SELCAL for ARQ Operation

In order to operate in Mode A, it is necessary to use SELCAL system. A SELCAL for the AMTOR communication consists of our capital letters and is usually formed combining the first letter together with the last three letters of a call sign. Thus the SELCAL for JI1ZNZ should be "JZNZ".

Note: Numbers are not to be used.

How to store your SELCAL?	Press [**ESC**] [**H**] + 4 letters
How to display your SELCAL?	Press [**ESC**] [**?**]
How to send SELCAL of other ARQ station?	Press [**ESC**] [**A**] + 4 letters

Note: Your SELCAL is displayed following to **HC=**

NOTE for the operation in AMTOR Modes

1. Operate transceivers in USB Mode.
2. Operation speed is fixed at 100 baud.
3. Assign MARK frequency used in RTTY Modes (1275 Hz and 2125 Hz) for Y frequency and SPACE frequency for B frequency

6.3 Mode B (FEC, Forward Error Correction)

In Mode B, message is transmitted unilateraly to any number of stations. Transmitting/receiving changeover is not performed.

Signals are transmitted continuously at the speed of 100 bauds in the following procedure:

Example To transmit "ABCDEF..*.. GHI" (..*.. stands for typing pause)

PH2 PH1 PH2 PH1 A PH1 B PH1 C A D B E C F D PH2 E PH2 F G PH1 H PH1 I

PH1 and PH2 represent phasing signals. They are transmitted regularly at the start of each contact and every 32 characters for synchronization. They are also sent when signals fade out temporarily. Each seven-bit character is transmitted again in five signals, so that the receiver can select which of the two passes the 4B3Y ratio test.

Operation in Mode B

Set the unit in Mode B by pressing [**ESC**] [**M**] [**4**]. The waiting state is common to Mode A, Mode B and SEL-FEC Mode. The keyboard instruction [**ESC**] [**B**] starts transmission of Mode B signal.

The keyboard instruction [**ESC**] [**D**] or [**TAB**] ends a contact, then both sending and receiving stations return to the waiting status. The keystroke [**ESC**] [**W**] returns only a sending station to the waiting status.

6.4 SEL-FEC (Selective Mode B)

SEL-FEC is for selective broadcast to one or more stations. Operation in this mode is very similar to that in FEC Mode except that receiving stations are restricted to specified ones whose SELCAL correspond to that sent by a station sending in SEL-FEC Mode.

The system of transmitting signal is the same for FEC like that phasing signals are transmitted at the start of each contact for synchronization. Each data is sent twice in every five signals so as to avoid any possible reception of error.

Note: You have necessity of receiving the contact from the beginning for synchronization because phasing signals are transmitted only at the beginning of the contact.

The to differences from FEC Mode are, that first the transmission of the SELCAL begins the contact as in ARQ Mode. Only stations whose SELCAL match the one transmitted by a station sending in SEL-FEC Mode are able to decode the message. Secondly, all transmitted signals are constructed with inverted 4B3Y-ratio code.

Operation in SEL-FEC Mode

Set the unit in SEL-FEC Mode by pressing [**ESC**] [**M**] [**4**]. The waiting status of SEL-FEC Mode is common to Mode A and Mode B. The keystroke [**ESC**] [**C**] and four-letter-SELCAL of other SEL-FEC stations begins a contact. When you are the slave station, the Θ-777 judges first which mode of ARQ or FEC is transmitted as soon as receiving phasing signal. At this moment, LED indication changes from the waiting state to 'TOR-B'. Then the unit judges the mode to be SEL-FEC upon receiving any inverted data. LED indication of this moment becomes 'SEL-FEC'.

'REMOTE' LED illuminates when the SELCAL transmitted by a station sending in selective Mode B corresponds to your SELCAL.

To end a contact, press [**ESC**] [**D**] or [**TAB**], so that both sending and receiving stations return to the waiting status.

SELCAL for SEL-FEC Operation

To store your SELCAL	Press [**ESC**] [**F**] + 4 letters
To display your SELCAL	Press [**ESC**] [**?**]
To transmit SELCAL of other SEL-FEC station	Press [**ESC**] [**C**] + 4 letters

Note: Your SELCAL is displayed following to **GC=**

6.5 Mode L (Listen to TOR - ARQ, FEC, SEL-FEC)

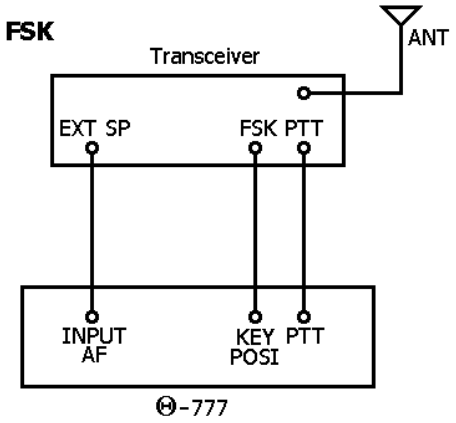
In Mode L the Θ-777 monitors an ARQ contact, FEC broadcast and SEL-FEC broadcast. This mode is used only for receiving.

While monitoring an ARQ contact and a SEL-FEC broadcast, you may receive a meaningless four-letter combination repeatedly. This, however, does not always mean an error. Most of the time these four letters are the SELCAL of the slave station being called by a master station. The phenomenon often occurs when your monitor the contact which is trying to get synchronized.

Example of the screen display: **JZMZ JZNZ JZNZ JZNZ JZNZ**

Setting of Mode L is performed by pressing [**ESC**] [**M**] [**5**].

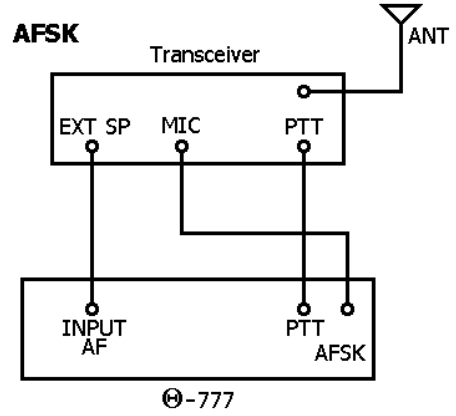
6.6 Connections



1) Emitted frequency is based on the FSK generator of your transceiver.

2) The FSK connection should be made the same as for RTTY (Baudot & ASCII).

3) Connect the PTT jacks of your transceiver and the Θ-777.



1) The tone pair exclusive for ARQ/FEC codes and both Low tone and High tone pair for RTTY use are available.

2) The connections should be made the same as for RTTY (Baudot & ASCII).

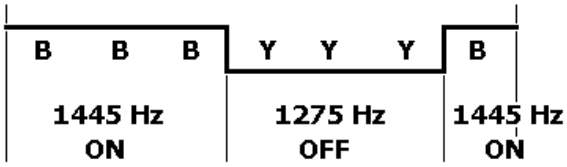
3) Connect the PTT jacks of your transceiver and the Θ-777.

<u>FSK, CW OUT and AFSK OUT</u>

Lo tone, Shift Width 170 Hz

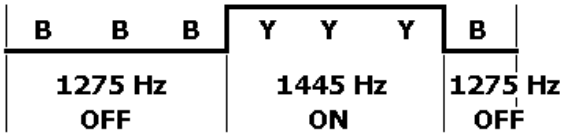
SENSE: OUT-N

AFSK OUT
FSK KEYER



SENSE: OUT-R

AFSK OUT
FSK KEYER



6.7 Introduction to the LED Indicators

In Mode A

TOR-A Indicates that the unit is operating in Mode A.

Note: TOR-A, TOR-B and SEL_FEC LEDs illuminate simultaneously in the waiting status. Indication changes to TOR-A as soon as transmit/receive any signal.

MAS Indicates that your station is the master station: red is for ISS and green for IRS

SLV Indicates that you are the slave station: red is for ISS and green for IRS

WAIT Waiting for a call from a distant station (the initial state in Mode A)

U.PHA Slave station is under phasing and sending back a control code responding to the call from MS

TRAFF Transmit/receive state between MS and SS

IDLE Transmitting or receiving idle signal. It starts idling when transmission is broken for any reason.

RQ ISS is requested to repeat the data; IRS is requested to repeat the CS control signal

ERR Not able to receive data or CS control signal correctly

REMOTE Indicates that the remote terminal on the rear panel is ON. Manual on/off switching is available by pressing [**ESC**] [**N**].

FIG Indicates that the case of transmitting/receiving signal is Figure. Manual LTR/FIG switching is available by pressing [**ESC**] [**X**]

LTR Indicates that the case of transmitting/receiving signal is Letter

CS-1
CS-2 IRS transmits a control signal replying to the ISS's three-character data. CS-1 and CS-2 illuminate alternately.
ISS receives a control signal from IRS

Note: When 'ERR' or 'RQ' LED illuminates indicating that three-character data are not received correctly, only CS-1 or CS-2 illuminates continuously.

CS-3 IRS transmits a control signal which makes an opportunity off ISS/IRS changeover ISS receives the control signal.

In Mode B

TOR-B Indicates that the unit is operating in Mode B.

Note: TOR-A, TOR-B and SEL_FEC LEDs illuminate simultaneously in the waiting status. Indication changes to TOR-B as soon as transmit/receive any signal.

WAIT Waiting for a call from a distant station (the initial state in Mode B)

TRAFF In transmit or receive state in Mode B

IDLE Transmitting or receiving idle signal when transmission is broken for any reason.

In SEL-FEC Mode

SEL-FEC Indicates that the unit is operating in SEL-FEC Mode.

Note: TOR-A, TOR-B and SEL-FEC LEDs illuminate simultaneously in the initial state. In transmission, LED indication changes to SEL-FEC upon transmission of any signal. In receiving, indication changes to FEC as soon as the unit judges the signal to be FEC and then it changes to SEL-FEC upon receiving inverted 4B3Y ratio signal.

WAIT Waiting for a call from distant station (the initial state in SEL-FEC Mode)

TRAFF In transmitting/receiving state in SEL-FEC Mode

IDLE Transmitting or receiving idle signal when transmission is broken for any reason.

REMOTE Indicates that the SELCAL transmitted from a station sending in SEL-FEC Mode corresponds to your own SELCAL when you are the station receiving in SEL-FEC Mode. Remote terminal on the rear panel becomes on.

In Mode L

TOR-L Indicates that the unit is operating in Mode L.

WAIT Waiting for receiving signals (the initial state in Mode L)

TRAFF Receiving contacts operating in ARQ, FEC and SEL-FEC

IDLE Receiving idle signal sent when transmission is broken for any reason.

RQ Receiving three continuous "RQ" signals.

ERR Receiving the same three-character-block.

7. VARIOUS FUNCTION KEYS

[**ESC**] [**A**] + 4 letters *(*1)* Transmits SELCAL of other ARQ station

[**ESC**] [**B**] Starts transmission in AMTOR Mode B

[**ESC**] [**C**] Activates/deactivates SELCAL function in other modes Than AMTOR

[**ESC**] [**C**] + 4 letters Transmits SELCAL of other station in SEL-FEC Mode

[**ESC**] [**D**] or [**TAB**] Unkeys the PTT line when in automatic PTT line keying.
Keys/unkeys the PTT line when in manual PTT line keying

[**ESC**] [**E**] Activates/deactivates Echo Back function

[**ESC**] [**F**] + 4 letters Programs your own SELCAL in SEL-FEC Mode

[**ESC**] [**G**] + 5 digit-combination of 1 and 0 *(*2)*
Inverts the polarity of the desired bit of 5-bit Baudot code in Bit Inversion Mode. Insert 1 to the bit you want to invert

[**ESC**] [**G**] [**2**] *(*3)* Increases the value by one considering the five-digit combination as a numerical value in binary notation

[**ESC**] [**H**] + 4 letters Programs your own SELCAL in ARQ mode

[**ESC**] [**I**] Transmits CW ID in RTTY (Baudot, ASCII and JIS)

[**ESC**] [**J**] + channel number + message + [**ESC**]
Enables channel memory programming (Refer to page 23 for details.)

[**ESC**] [**K**] [**1**] Automatic/manual PTT line keying is available

[**ESC**] [**K**] [**3**]
- In Japanese CW Mode:
  judges **- • • • -** code to be ¿. Another keystroke judges the code to be BT
- In Baudot Mode:
  activates/deactivates U.S.O.S. feature

[**ESC**] [**K**] + [**4**], [**5**] or [**6**] Selects input terminal (4=TTL, 5=AF, 6=ANTI NOISE)

[**ESC**] [**L**] + [**0**], [**1**], [**2**] or [**3**] Selects automatic CR/LF insertion (0=non, 1=64 char., 2=72 char., 3=80 char.)

[**ESC**] [**M**] + [**1**] through [**8**] Selects desired mode (1=ASCII, 2=JIS, 3=Baudot, 4=AMTOR Mode A, B and SEL-FEC, 5=AMTOR Mode L, 6=Bit Inversion, 7=Continental CW, 8=Japanese CW)

[**ESC**] [**M**] [**0**] Automatically judges mode, speed and polarity of received RTTY signal and starts decoding the signal

[**ESC**] [**N**] Manual on/off switching of REMOTE terminal

[**ESC**] [**O**] + [**1**] or [**2**] Reverses/normalizes the polarity of signals (1=receiving signal, 2= transmitting signal)

[**ESC**] [**P**] Activates data preloading/buffer transmission

[**ESC**] [**Q**]	Outputs QBF test message. Any keystroke stops the transmission
[**ESC**] [**R**] + channel number + number (1–9)	Transmits the message memorized in each channel memory desired number of times (Refer to '4. Data Transmission' chapter)
[**ESC**] [**S**] + 3 digits	Speed settings
[**ESC**] [**S**] [**A**]	Autotrack of speed is available. The speed is indicated on the screen
[**ESC**] [**S**] [**C**]	Returns the initial speed setting to the factory original setting
[**ESC**] [**S**] [**R**]	Programs the desired speed setting of the mode
[**ESC**] [**T**] + [**1**] through [**6**]	Tone setting
[**ESC**] [**U**]	Starts CW random output. Any keystroke stops the transmission
[**ESC**] [**V**]	Decreases delay time (Td msec.) by 2 msec.-step
[**ESC**] [**W**]	Returns only ISS to the waiting status in AMTOR Modes
[**ESC**] [**W**] + number (0–9)	CW weight setting, 1:3 – 1:7
[**ESC**] [**X**]	Changes the case of received signal in Japanese CW, Baudot or AMTOR Modes
[**ESC**] [**Y**]	Transmits "RY" test message. Any keystroke stops the transmission.
[**ESC**] [**Z**] or [**DEL**] *(*4)*	Deletes miswritten characters in the buffer or channel memory.
[**ESC**] [**4**]	Activates/deactivates automatic reply to 'WRU' control code.
[**ESC**] [*/*]	- in ARQ Mode: IRS transmits ISS/IRS changeover code to ISS. Upon ISS's receipt of the code, IRS becomes ISS and vice versa. - in Baudot Mode: Activates/deactivates Diddle feature.
[**ESC**] [**?**]	Displays operating status and your own SELCAL on the screen.
[**ESC**] [↵] or [**CTRL-X**]	Clears the buffer memory.
[**+**] [**?**]	Switches transmitting and receiving role in ARQ Mode. ISS should send combination of '+' and '?'. Upon receipt of these two signals, IRS becomes ISS and vice versa.
[**$**] or [**WRU**]	Transmits 'WRU' control code in ARQ, FEC, SEL-FEC, Baudot and Bit Inversion Mode.

Note *1: When you use a Baudot terminal, press 'BLANK' key instead of [ESC] because the 'ESC' code is not available with the Baudot terminal.

Note *2: When more than 5 digits are inserted, the last 5 digits are valid. If other characters than 1 and 0, the unit gets out of this function.

Note *3: When other character the 2 is pressed, the unit gets out of this function.

Note *4: Only [DEL] key is available to deletes miswritten characters in the channel memory.

8. APPLICATION

Recording

Set the mode and speed. – Connect AFSK OUT jack to the microphone terminal of the cassette tape recorder. – Set GAIN control of the back panel to the medium level so as to prevent excess input to the recorder. – Set the recorder in recording status. – Send the data which you want to record from the Θ-777. – Stop the recorder after the data transmission is completed. Make sure to let the cassette tape run for a few seconds before stopping.

Play back

Adjust the mode and speed to the recording state of cassette tape recorder. – Clear the screen if required. – Connect the earphone terminal to INPUT AF jack in other modes than ARQ and FEC. – Adjust the volume of the recorder to make output level about 100 mV to 1 V_{P-P}. Any tone should be adjusted to the highest position at this moment. – Sentences are read and displayed on the screen when playback starts. Depressing [**ESC**] [**E**] activates the ECHO-BACK function and the unit outputs the received data to AFSK, CW, FSK jacks at the same time as the reading. You can use another tape recorder for storage. – To release this function, redepress [**ESC**] [**E**].

---

9. MAINTENANCE

Do not open the unit unnecessarily unless for purposes specified below nor touch the parts not corresponding to each purposes even in such cases.

Turn the power off and pull out the plug of power supply cord before opening the unit. Remove four pieces of M3 screw at the top case to open the unit.

Cross-hatch Tuning

The X and Y terminals for the cross-hatch tuning aid are on the PC board. Please refer to the Oscilloscope section on page 8.

Dip Switches Setting

The speed and the mode are selected by eight dip switches on the PC board according to a microcomputer. Refer to **Setting of the Dip Switches** section on page 16.

Fuse Replacement

The replacement must be done after eliminating the cause why the fuse burns out. Replace the fuse which is in the fuse holder on the PC board with a midget fuse of 2 A.

Please inquire of our distributor/dealer in your district regarding adjustment or when you have a problem with the unit.

When sending a unit to our distributor, please include a complete description of any and all problems.

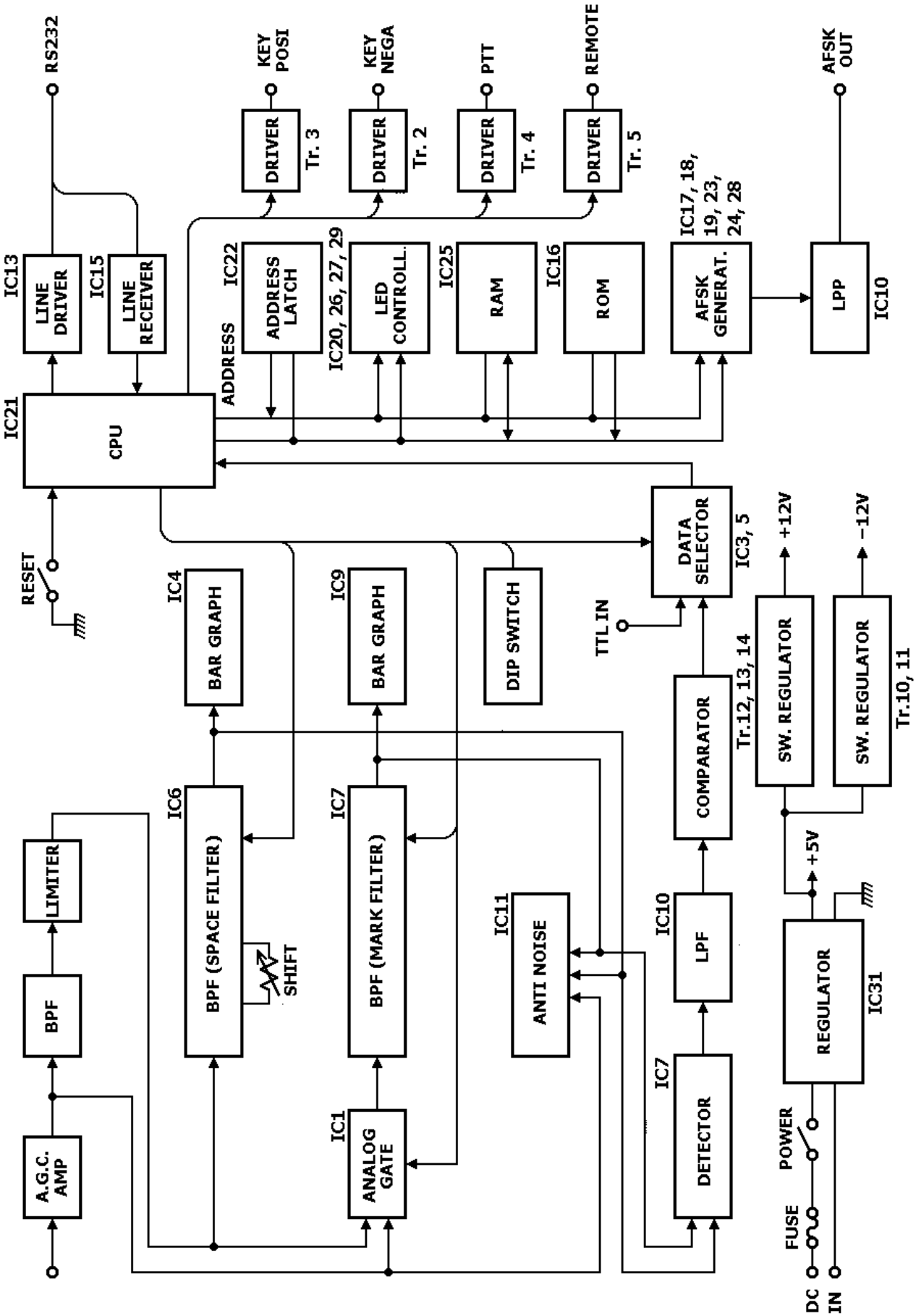
CODE TABLE

KEY	ASCII		BAUDOT (CCITT No. 2) ARQ/FEC/SEL-FEC		MORSE	
	SCREEN DISPLAY	OUTPUT CODE	SCREEN DISPLAY	OUTPUT CODE	SCREEN DISPLAY	OUTPUT CODE
! 1	! 1	! (21H) 1 (31H)	! 1	! 1	! 1	····-· (UNDERSTOOD) ·----
" 2	" 2	" (22H) 2 (32H)	BLK 2	LTR 2	" 2	·-··-· ··---
# 3	# 3	# (23H) 3 (33H)	# 3	# 3	# 3	-·-·- (STARTING) ···--
$ 4	$ 4	$ (24H) 4 (34H)	$ 4	WRU 4	$ 4	···-·- ····-
% 5	% 5	% (25H) 5 (35H)	BLK 5	LTR 5	BLK 5	**SP** ·····
& 6	& 6	& (26H) 6 (36H)	& 6	& 6	BLK 6	**SP** -····
' 7	' 7	' (27H) 7 (37H)	' 7	' 7	' 7	·----· --···
(8	(8	((28H) 8 (38H)	(8	(8	(CR/LF 8	-·--· ((, KN) ---··
) 9	) 9	) (29H) 9 (39H)	) 9	) 9	) 9	-·--·- ----·
 0	SP 0	SP (20H) 0 (30H)	SP 0	SP 0	SP 0	**SP** -----
= -	= -	= (3DH) - (2DH)	= -	= -	= -	-···- (=, BT)
~ ^	~ ^	~ (7EH) ^ (5EH)	BLK BLK	LTR LTR	BLK ^	**SP** ·-···· (AS)
| \	| \	| (7CH) \ (5CH)	BLK BLK	LTR LTR	BLK \	**SP** ·-··-· (SEPARATION)
Q	q Q	q (71H) Q (51H)	Q Q	Q Q	Q Q	--·- --·-
W	w W	w (77H) W (57H)	W W	W W	W W	·-- ·--
E	e E	e (65H) E (45H)	E E	E E	E E	· ·
R	r R	r (72H) R (52H)	R R	R R	R R	·-· ·-·
T	t T	t (74H) T (54H)	T T	T T	T T	- -
Y	y Y	y (79H) Y (59H)	Y Y	Y Y	Y Y	-·-- -·--

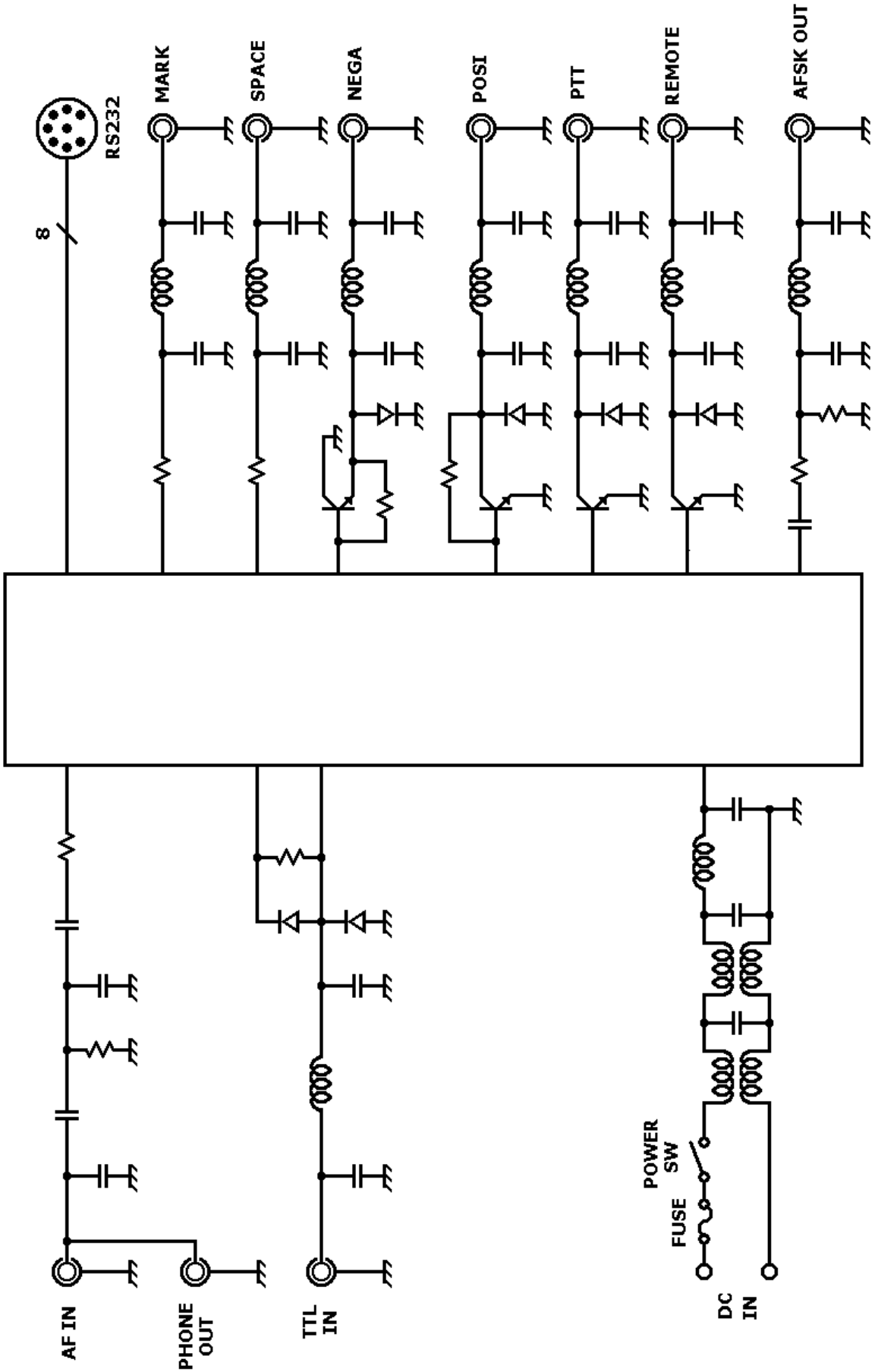
KEY	ASCII		BAUDOT (CCITT No. 2) ARQ/FEC/SEL-FEC		MORSE	
	SCREEN DISPLAY	OUTPUT CODE	SCREEN DISPLAY	OUTPUT CODE	SCREEN DISPLAY	OUTPUT CODE
U	u U	u (75H) U (55H)	U U	U U	U U	••– ••–
I	i I	i (69H) I (49H)	I I	I I	I I	•• ••
O	o O	o (6FH) O (4FH)	O O	O O	O O	––– –––
P	p P	p (70H) P (50H)	P P	P P	P P	•––• •––•
` @	` @	` (60H) @ (40H)	BLK BLK	LTR LTR	BLK @	**SP** ••–•
{ [	{ [	{ (7BH) [(5BH)	BLK BLK	LTR LTR	BLK BLK	**SP** **SP**
A	a A	a (61H) A (41H)	A A	A A	A A	•– •–
S	s S	s (73H) S (53H)	S S	S S	S S	••• •••
D	d D	d (64H) D (44H)	D D	D D	D D	–•• –••
F	f F	f (66H) F (46H)	F F	F F	F F	••–• ••–•
G	g G	g (67H) G (47H)	G G	G G	G G	––• ––•
H	h H	h (68H) H (48H)	H H	H H	H H	•••• ••••
J	j J	j (6AH) J (4AH)	J J	J J	J J	•––– •–––
K	k K	k (6BH) K (4BH)	K K	K K	K K	–•– –•–
L	l L	l (6CH) L (4CH)	L L	L L	L L	•–•• •–••
+ ;	+ ;	+ (2BH) ; (3BH)	+ ;	+ ;	+ CR/LF ;	•–•–• –•–•–• (+, AR)
* :	* :	* (2AH) : (3AH)	BLK :	LTR :	* CR/LF :	••••–– (SK) ––•••
}]	}]	} (7DH)] (5DH)	BLK BLK	LTR LTR	BLK BLK	**SP** **SP**
Z	z Z	z (7AH) Z (5AH)	Z Z	Z Z	Z Z	––•• ––••
X	x X	x (78H) X (58H)	X X	X X	X X	–••– –••–
C	c C	c (63H) C (43H)	C C	C C	C C	–•–• –•–•

KEY	ASCII		BAUDOT (CCITT No. 2) ARQ/FEC/SEL-FEC		MORSE	
	SCREEN DISPLAY	OUTPUT CODE	SCREEN DISPLAY	OUTPUT CODE	SCREEN DISPLAY	OUTPUT CODE
V	v V	v (76H) V (56H)	V V	V V	V V	···– ···–
B	b B	b (62H) B (42H)	B B	B B	B B	–··· –···
N	n N	n (6EH) N (4EH)	N N	N N	N N	–· –·
M	m M	m (6DH) M (4DH)	M M	M M	M M	–– ––
< ,	< ,	< (3CH) , (2CH)	BLK ,	LTR ,	BLK ,	····· (HH) ––··––
> .	> .	> (3EH) . (2EH)	BLK .	LTR .	BLK .	**SP** ·–·–·–
? /	? /	? (3FH) / (2FH)	? /	? /	? /	··––·· –··–·
_ _	_ _	_ (5FH) _ (5FH)	BLK BLK	LTR LTR	_ _	··––·– ··––·–
CR	CR	CR (0DH)	CR	CR	CR	**SP**
LF	LF	LF (0AH)	LF	LF	LF	**SP**

BLOCK DIAGRAM



INPUT/OUTPUT CIRCUIT



SPECIFICATIONS

Code	Morse (Continental & Japanese CW), ASCII (RTTY), Baudot (RTTY), JIS (RTTY), ARQ (AMTOR Mode A, Mode L), FEC (AMTOR Mode B), SEL-FEC, BIT-INVERSION		
Speed	Morse	Receiving:	5 – 100 Words/Minute (AUTOTRACK)
		Transmitting:	5 – 100 WordsMinute
	RTTY	(Baudot, ASCII, JIS):	12 – 200 Baud
	TTL Level	(Baudot, ASCII, JIS):	12 – 600 Baud
	ARQ/FEC:		100 Baud
Input	AF Input / TTL Level Input		Impedance 8 Ω
AF Input Frequency	CW: 830 Hz		
	RTTY (Baudot, ASCII, JIS):	Mark	1275 Hz (Low Tone)
			2125 Hz (High Tone)
		Shift	170 Hz – 850 Hz (Variable Shift)
Output	Keying Output:	CW	80 mA, 200 V
		FSK	80 mA, 200 V
AFSK Output Frequency	CW: 830 Hz		
	RTTY (BAUDOT, ASCII, JIS):	Mark	1275 HZ (Low Tone)
			2125 Hz (High Tone)
		Shift	170 Hz, 425 Hz, 850 Hz
Interface	RS232C, TTL Level		
	ASCII	Full Duplex, Half Duplex	
	Baudot Code	Half Duplex	
Buffer Memory	Input Buffer Memory:	768 characters	
	Output Buffer Memory:	512 characters	
Message Memory	64 characters × 4 channels 32 characters × 7 channels 16 characters × 4 channels		
Output Impedance for Oscilloscope	200 kΩ		
Power Supply	DC 12 V, 700 mA		
Dimensions	234 mm (W) × 256 mm (D) × 64 mm (H)		
Accessories	Instruction Manual - 1, Pin Plug - 8, Coaxial Cable - 4 m, 8P DIN Connector - 1		

The Θ-777 should be operated under condition of temperature 5 °C – 40 °C.

The specification are subject to change without prior notice.