PROGRAMMING SOFTWARE

KPG-28D/KPG-32D

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PROGRAMMING MANUAL Ver. 1.01

KENWOOD CORPORATION

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HANDLING OF FLOPPY DISKS

Observe the following points when handling the programming software disks:

* Never touch the magnetic surface of the floppy disks.

* Keep magnets and magnetic objects away from the floppy disks.

* Do not bend the floppy disks.

* Do not place the floppy disks in areas that are unusually hot, humid, cold or dry.

* Always insert the 3.5" floppy disk back into its case after use.

TABLE OF CONTENTS

1. INTRODUCTION

This document describes the functional specifications of the Integrated
Controller Module for the following KENWOOD transceivers:

- TK-759/859 (multi-channel mobile)

- TK-752/852 (2-channel mobile)

- TK-259/359 (multi-channel portable)

2. MAIN FEATURES

* Integrated selcall encode/decode, DTMF encode, and QT/DQT transmit and
  receive.

Multi-channel models:
* Up to 250 simplex or semi-duplex channels.

* Channel scanning with priority scanning and queuing/call-back.

Mobile:
* Five keys (multi-channel) or three keys (2-channel) for basic
  operation; fully programmable, also multiple functions per key
  (press, hold, shift and release).

* Keypad/microphone increases operating convenience.

* Microphone connector on mobile allows connection of standard microphone,
  keypad/microphone and PC for programming and remote control.

Portable:
* Six keys for basic operation (x1, x10, A, LMP, RESET, CALL); fully
  programmable with multiple functions per key (Press, Hold, Shift, Release).

* Optional KDM-7 keypad increases operating convenience.

* Speaker-microphone jack to connect either an (optional) external speaker-
  microphone for convenience or a PC for programming.

3.   SUMMARY OF FUNCTIONS

3.1 Channel switching and scanning

* Capacity for 250 channels (multi-channel models only)

* Independent frequency for transmit and receive

* Receive-only channels possible

* Programming in 5.00 and 6.25 kHz steps

* Supports multiple frequency bands

* Scan for carrier, QT/DQT, selcall 1st tone or both QT/DQT and selcall
  together

* Configurable behavior of PTT while scanning

Multi-channel only:
* 4-digit (portable) or 9-digit (mobile) channel readout displays
  alphanumeric characters

* Maximum 10 scan groups

* Unlimited number of channels per scan group

* One priority channel per scan group

* User programmable scan list for each scan group; changeable priority
  channel

* System selectable scan wait period, scan resume time, and scan
  configuration

* Group selectable priority channel, look back time A and look back time B

3.2 General

* PTT timeout timer

* TOT pre-alert

* TOT rekey time

* TOT reset time

* Startup channel selection

* Restore last selected channel upon power-up

* Default channel or selcall selection by keypad

* Different display formats to optimize for most frequently used facilities

* Up/Down/Shift for basic operation of selcall by using the keys

* Near-compatibility mode (keys and display) for existing transceivers

Mobile only:
* Fully user-definable function per key for press, hold, shift, and
  release

* Hook control functions

* External alert output for horn relay

* External emergency key input for foot switch

Portable only:
* Each of the six keys (x10, x1, A, LMP, RESET, CALL) can be programmed for
  Press, Hold, Shift, and Release functions

3.3 Selective calling, decoding

* Twelve tonesets: ZVEI, CCIR, EEA, DZVEI, PZVEI, PCCIR, PDZVEI, ZVEI-2, EIA,
  Natel, AP-369 and a KENWOOD-specific toneset

* KENWOOD-specific toneset allows setting of desired tones

* Decode format allows decoding of up to 15 tones per packet

* Simultaneous decoding of multiple formats; 5-tone, 6-tone and 2x5-tone

* Decode formats allow multiple decode addresses with fixed and channel
  dependent digits, keypad-selectable digits, and receive digits

* Queuing of up to 5-tones on arbitrary positions within decoded packets

* Queue stores up to 6 entries, depending on the capacity needed per entry

* Repeat and group tone decoding, different alerts for incoming group calls

* Group selectable toneset and decode format, thus allowing the same
  transceiver to be used in different systems

* Remote stun, revive, and kill

* Remote close (Philips and Motorola methods)

* Auto-close (Bosch method)

* Display of received messages

3.4 Selective calling, encoding

* Twelve tonesets; selection of tonesets within encode formats allows
  switching of tonesets while transmitting

* Tone duration and pause length selectable within encode format from 1 to
  7000 ms, also changing tone duration within sequences is possible

* Any encode format possible from 1 to 28 tones, containing fixed, channel-
  dependent, keypad-selectable digits, and receive digits

* Up to 5-tones selectable by optional KDM-7 DTMF keypad (portable) or
  KMC-23,24 microphone keypad (mobile) or by using up/down keys

* Automatic repeat tone generation

* Free-dialing through telephone interconnect to PABX/PSTN, using selcall
  packets for transferring up to 28 digits

* Single-tone transmission possible for any tone with frequency between 300
  and 3000 Hz and duration between 1 and 7000 ms

* Selcall ANI upon press and/or release of PTT

* Automatic repeat call until acknowledged

* Carrier, QT/DQT, open and close lockouts

3.5 QT

* 39 standard EIA tones plus user-selectable tone frequency in steps
  of 0.1 Hz

* Channel selectable encode/decode tone

* Trailing QT mute to suppress noise on receiving transceiver

* Two QT PTT lockout conditions

3.6 DQT

* Motorola DPL compatible

* Channel selectable encode/decode DQT tone

* Two DQT PTT lockout conditions

* Tone burst upon PTT release to suppress trailing noise

3.7 DTMF

* PTT overdialing (press keys on keypad while pressing PTT)

* Key buffer, selectable tone and pause duration

Mobile only:
* PTT 'on hook' dialing: enter dialing string, then transmit call

4. USER INTERFACE

This chapter describes the user interface in detail. The next chapter
(OPERATION) describes how to use the interface.

4.1 Keys

Mobile:
In its basic configuration, the mobile provides a number of keys for
operation. The multi-channel mobile provides 5 keys and the 2-channel mobile
provides 3 keys.

Portable:
The portable transceivers only have 6 keys apiece (excluding the optional
KDM-7 keypad); however, each key can be programmed with multiple functions
(Press, Hold, Shift, Release), giving the user the ability to perform many
different functions.

4.1.1 Key actions

You can program the keys with up to four functions each according to the
following actions: Press, Hold, Shift, and Release.

Press: Press key to execute function.
Hold: Press and hold key for programmed time to execute function.
Shift: Press the Shift-key then key to execute function.
Release: Press key and release within programmed time to execute function.

Note: The time for the Hold-Release actions are programmed by setting the
"Hold delay" parameter.

A Press-function is immediately executed upon pressing the key. A Hold-
function will be executed after holding down the key for the programmed time.
This is confirmed by a double-beep. If a Hold-function is assigned to a key,
normally no Press-function is assigned to prevent a double action. The Hold-
and Release-functions could be used together since by releasing the key
within the programmed time the Release-function is executed while the Hold-
function is not. Likewise, by holding the key for the programmed time the
Hold-function is executed while the Release-function is not.

In the same manner, a Press-function and a Shift-function could be used
together. If the Shift key is pressed the transceiver toggles from Press
mode to Shift mode and will execute the Shift-functions instead of the Press-
functions. Note that there is no "unshift" command, instead the transceiver
simply resets to Press mode after one of the keys is pressed. The unit
resets to Press mode regardless of whether a function is assigned to the
pressed key. Since the shift-key is included among the programmable keys,
you can toggle between Shift mode and Press mode by simply pressing the
shift-key repeatedly.

Note: If you assign a Press-function and a Hold- and/or Release-function to
the same key, the Press-function and the Hold- or Release-function will be
executed; depending upon how long you hold down the key. Similarly, if you
assign a Shift-function and a Hold- and/or Release-function to the same key,
the Shift-function and the Hold- or Release-function will be executed;
depending upon how long you hold down the key.

See section 4.7 for a full overview of available key functions.

4.1.2 Available keys

The five keys (multi-channel mobile), three keys (2-channel mobile) or six
keys (portable) on the transceiver are fully programmable via the KPG-
28D/KPG-32D software package.

4.1.3 Suggested operation of keys

Mobile:

key	Release action	Hold action
1	monitor	squelch mute/unmute
2	transmit normal call	transmit status call
3	selcall open/close	external alert on/off
4	selcall x10 or shift	priority scan on/off
5	selcall x1 or up	scan on/off
Emg	N/A	N/A

Emg (Emergency switch): Provided as an internal switch (cf. service manual).
Portable:

Key	Release action	Hold action
RESET	monitor	squelch mute/unmute
CALL	transmit normal call	transmit status call
A	selcall open/close	external alert on/off
x10	selcall x10 or shift	priority scan on/off
x1	selcall x1 or up	scan on/off
LMP	lamp on/off	lamp on/off

The PTT operates as Push-To-Talk. Several options are available to prevent
speech transmission; if one of these conditions occurs, an error beep is
emitted.

4.2 Keypad

The full range of transceiver capabilities can only be utilized when the
optional KDM-7 keypad (portable) or KMC-23,24 microphone (mobile) is
connected.

Each key on the keypad is fully user-configurable using the programming
software. For each key a Press-, Hold-, Shift-, and/or Release-function can
be programmed.

In addition to the numerical keys, *, #, A, B, C and D keys are available for direct selection of functions. It is suggested that one of these keys is used as the shift-key to activate and de-activate Shift mode. Although it is possible to use the Hold action, the Shift action adds security to function accessibility.

For example:

Key	Release action	Hold action
1	1	group digit
2	2	freedial selcall
3	3	freedial DTMF
4	4	long-tone
5	5	status call
6	6	scan on/off
7	7	channel entry mode
8	8	selcall entry mode
9	9	queue entry mode
*	call	N/A
#	monitor	N/A
A	shift on/off	N/A
B	N/A	code lock
C	clear digit	clear all
D	N/A	scan programming

While the PTT is pressed, the operation of the keypad is changed to Encode DTMF overdial. This feature is described in section 5.7.2 of this document.

4.3 Channel select

Multi-channel:
A turn-knob is provided to select the transceiver channel. Turn the knob clockwise to change to the next channel, counterclockwise to change to the previous channel. Note that the channels are selected in the pre-programmed order, which can be different from the order of channel numbers as shown on the display.

Channels with a numerical readout can also be selected with the keypad; channel readouts with alphanumeric characters can only be selected using the channel knob.

Mobile 2-channel:
Each time the Channel Select switch is pressed, the transceiver toggles between channels 1 and 2.

4.4 Display

Mobile multi-channel:
The Liquid Crystal Display supports the following features:

* Nine large digits
* Indicator for transmit   TX
* Indicator for channel busy   BUSY
* Indicator for monitor   MON
* Indicator for squelch defeat   SQ
* Indicator for called   CALL
* Indicator for auxiliary   AUX
* Indicator for included channels in scan list   ADD

The indicators have a fixed meaning, as described in the table below.

Indicator	Off	On	Flashing
CALL	no alert/trans	ext.alert	transfer call
TX	receive	transmit	
BUSY	channel clear	channel busy	
MON	close	open	
SQ	mute	unmute	
AUX	auxiliary off	auxiliary on	
ADD	not in scan list	in scan list	

Note that the operation of the external/alert symbol can be different
depending on the configuration of the "ext.alert/transfer" parameter. The
possibilities that exist are listed in the table below.

Ext. Alert/Transfer Parameter	Selection	Symbol State
None	–	Off
Ext. alert	Off	Off
	Ext. alert	On
Transfer	Off	Off
	Transfer	On
Ext/trans	Off	Off
	Ext. alert	On
	Transfer	Flash

The following table lists the display patterns for various modes.

Function	Display pattern
AUX2 On	xxxxxxxx.
Shift On	xxxxx.xxxx
ACK indicator On	xx.xxxxxxx
Scrambler On	x.xxxxxxxx
Mon-QT/DQT On	xxxxxx.xxx

Mobile 2-channel:

LED indication:

	Selected CH LED	Unselected CH LED
CH Select	Orange/Lit	Not lit
Transmitting	Red/Lit	Not lit
Busy (squelch open)	Green/Lit	Not lit
Monitor On (no signal)	Orange/Flashing	Not lit
Monitor On (signal available)	Green/Flashing	Not lit
Talk Around On (no signal)	Orange/Lit	Orange/Flashing
Talk Around On (signal available)	Green/Lit	Orange/Flashing
Talk Around On (during transmission)	Red/Lit	Orange/Flashing
Public Address On (no signal)	Orange/Lit	Green/Flashing
Public Address On (signal available)	Green/Lit	Green/Flashing

	CH1 LED	CH2 LED	AUX LED
FPU (during communication)	Green/Lit	Green/Lit	
Checksum error	Orange/Flashing	Orange/Flashing	
User lock mode	Orange/Flashing	Orange/Flashing	Red/Flashing
Communication error	Red/Flashing	Red/Flashing	
Remote kill mode	Orange/Flashing	Red/Flashing	
Remote stun mode	Red/Flashing	Orange/Flashing	
No channel data	Not lit	Not lit	Red/Flashing
AUX on			Red/Lit
EEPROM data damaged	Red/Flashing	Green/Flashing	

Portable:
The Liquid Crystal Display supports the following features:

* Two small digits
* Four large digits
* Indicator for low transmit power   LO
* indicator for scan   SCN
* Indicator for channel busy   BUSY
* Indicator for monitor   MON
* Indicator for call   CALL
* Indicator for included channels in scan list   A
* Indicator for priority channel   P

Each of the seven indicators (LO, SCN, BUSY, MON, CALL, A, P) has a specific meaning depending on whether it's On, Off, or flashing according to the table below.

Indicator	Off	On	Flashing
LO	programmed transmit power	low transmit power	
SCN	scan off	scan on	
BUSY	channel clear	channel busy	
MON	close	open	
CALL	no queue mode		queue mode
A	not in scan list	in scan list	
P	non-priority channel	priority channel	

The following table lists the display patterns for various modes.

Function	Display pattern
ACK indicator On	xx x.xxx
Shift On	xx xx.xx
Mon-QT/DQT On	xx xxx.x
Scrambler On	xx xxxx.

4.5 Audible alerts

The following audible alerts are defined:

Power-on
Short beep for key Press
Double high/high beep for Hold action
Double high/low beep for error
24 different beeps to alert for incoming calls

In total 47 beep sequences are specified. A full overview of frequencies, duration and pauses of these 47 beep sequences is included in appendix G.

4.6 Error messages

Mobile:
The following error messages are provided:

E2P ERROR: EEPROM data damaged
SUM ERROR: Checksum error
COM ERROR: Communication error
 ERROR   :   Remote Kill mode

The error message is shown during the period of time the fault occurs. In
the following overview the operating restrictions and recommended actions are
explained:

E2P ERROR: The EEPROM data check is executed on power-up. The error message
will remain on the display until the transceiver is turned off, and operation
of the transceiver is not possible. The problem can be corrected by
re-programming the transceiver.

SUM ERROR: The Flash Memory data check is executed on power-up. The error
message will remain on the display until the transceiver is turned off, and
operation of the transceiver is not possible. The problem can be corrected
by re-programming the transceiver.

COM ERROR: This error message is displayed when data communication fails in
the PC mode. Check if the transceiver and the PC have been correctly
connected.

ERROR: This error message is displayed when the unit is put in Remote Kill
Mode; all internal data is erased. The message will remain on the display
until the unit is turned off; operation of the unit is not possible. The
problem can be corrected by reprogramming the transceiver.

When an error message is shown, all other symbols and digits are cleared.

Portable:
The following error messages are provided:

   ERR2 :   Remote Kill mode
   ERR3 :   PLL out-of-lock

The error message is shown during the period of time the fault occurs. In
the following overview the operating restrictions and recommended actions are
explained:

   ERR2: This error message is displayed when the unit is put in Remote Kill
Mode; all internal data is erased. The message will remain on the display
until the unit is turned off; operation of the unit is not possible. The
problem can be corrected by reprogramming the transceiver.

   ERR3: This error message is shown when the PLL (Phase Lock Loop) goes
out-of-lock. This condition is tested continuously during transmit and
receive. Channel switching is still possible. To correct this problem it is
recommended to check the programmed frequencies. If these frequencies are
correct, repair by looking at the service manual.

When an error message is shown, all other symbols and digits are cleared.
The error message is shown on the display as 'ERRn' where n is the error
number 2, or 3.

4.7 Key definitions

To each key action a key function can be attached. These key actions are
described in section 4.1.1. The programming software includes a key
definition matrix where for each key and each action a key function can be
selected.

```
Key Action       | Function
---------------------------------------------------------------------
Disable          |not assigned
0                |enter digit 0
1                |enter digit 1
2                |enter digit 2
3                |enter digit 3
4                |enter digit 4
5                |enter digit 5
6                |enter digit 6
7                |enter digit 7
8                |enter digit 8
9                |enter digit 9
Alert volume (4) |alert beep low/high
AUX (3)          |auxiliary on/off
AUX2 (3)         |auxiliary 2 on/off
Batt check (4)   |battery level confirmation
Channel ent. (1) |select channel entry mode
Channel temp (1) |temporary channel number display
Clear all (1)    |clear full dial buffer
Clear digit (1)  |erase one digit
Code lock        |lock operation of transceiver by means of a 4-digit code
Control tone     |select key beep on/off
Digit 1x (1)     |5th digit up
Digit 10x (1)    |4th digit up
Digit up (1)     |select digit up
Digit shift (1)  |select next digit
Display roll (1) |queue buffer redisplay
DTMF entry (1)   |select DTMF entry mode
Encode #1        |execute call format #1 (default: normal call)
Encode #2        |execute call format #2 (default: free-dialing using selcall)
Encode #3        |execute call format #3 (default: free-dialing using DTMF)
Encode #4        |execute call format #4 (default: long tone call)
Encode #5        |execute call format #5 (default: status call)
Encode #6        |execute call format #6 (default: emergency call)
ext/transfer (3) |switch on/off external alert and/or transfer function
Group digit (1)  |enter digit A
Hold delay       |change hold delay
Inv. display (4) |inverts display
Key lock         |Locks specific keys on the transceiver (see section 5.2.2)
Lamp on/off (4)  |turns lamp on/off
Low select (4)   |select power low/high
Message (1)      |queue and status number/message
Mode reset (1)   |reset to default entry mode
```

```
Mode select (1) |toggle between channel and selcall entry
Monitor         |selcall+QT/DQT monitor on/off
Mon-QT/DQT      |toggle SAT mute between open and close
Mon-selcall     |selcall open/close
Mon-mute        |squelch mute
Mon-unmute      |squelch unmute
Mon-toggle      |squelch mute/unmute
Monitoring (4)  |squelch (hold: unmute, release: mute)
Pri on (1)      |start priority scanning
Pri on/off (1)  |toggle priority scan on/off
Public ad. (3)  |public address on/off
Queue msg (1)   |queue/status
Queue mode (1)  |select queue mode
Queue next (1)  |select next queue entry
Queue select (1)|select next queue entry / default operation mode
Scan on (1)     |start scanning
Scan on/off (1) |toggle scan on/off
Scan+pri (1)    |toggle priority+scan on/off
Scan+pri on (1) |start both scan and priority scan
Scan prog (1)   |go to scan programming mode
Scrambler       |scramble select
Selcall ent. (1)|select selcall entry mode
Status ent. (1) |select status entry mode
Shift on/off    |shift mode on/off
SC/A confirm    |scramble code confirmation
Talk around(2)  |talk around on/off
Warning tone    |select alert beep on/off
```

(1) Multi-channel models only
(2) 2-channel models only
(3) Mobile only
(4) Portable only

The "Clear all" and "Clear digit" key functions operate as shown in the table below.

Entry Mode	Clear Digit-Key	Clear All-Key
Selcall entry	Initialize selcall address with default TX address	Initialize selcall with default TX address
Status entry	Initialize status address with 00000	Initialize status address with 00000
Free-dial entry (SELD)	Clear last entered digit	Clear all digits (full number)
Channel entry	Clear last entered digit	Clear all digits
Queue readout	Clear currently selected entry	Clear all queue entries

4.8 Display formats

The 4-character (portable) or 9-character (multi-channel mobile) alphanumeric
display is able to show a variety of different characters. These characters
are displayed in different formats depending on the mode the transceiver is
in.

4.8.1 Default display format

The multi-channel transceivers provide three default display formats, each
optimized for different applications. These display formats are:

1. Channel readout
This display format is preferred if selcall is not used, or if the selectable
selcall address digits are rarely changed. In the Optional features window
set the Normal display format parameter to "Channel".

Mobile:
The channel number is shown as a number or as a string of 9 characters on the
large digit section of the display. Some examples of this display format:

```
   CH  3  :   channel 3 selected
   CH199  :   channel 199 selected
POLICE-3  :   example of character string Police-3
```

Portable:
In this mode the channel number is shown as a 3-digit number or as a
4-character name on the large digit section of the display depending on
whether you choose "Numeric" or "Alphanum" for the Channel readout parameter.
In "Numeric" mode "ch" is shown in the lower left-hand corner of the display
and the channel number is taken from the "Ch No." column of the Channel
Information window. In "Alphanum" mode the channel name is taken from the
"Ch Name" column of the Channel Information window and shown in the large
digit section of the display. Some examples of this display format:

```
CH   3  :    channel 3 selected (Channel, Numeric)
CH 199  :    channel 199 selected (Channel, Numeric)
  POL3  :    example of character string Police-3 (Channel, Alphanum)
```

The available characters for the 4-digit (portable) or 9-digit (mobile)
alphanumeric channel readout are: 0 to 9, A-Z, /, \, -, _, *, +, =, #, , , (,
), @, $, %, and <space>.

2. Selcall address readout
This display format is preferred for applications where channel switching is
rarely, if ever used. In the Optional features window set the Normal display
format parameter to "Selcall". On the large digit section of the display,
the selectable part of the selcall address is shown.

Mobile:
If less than 5 digits are selectable, the selectable digits are shown at the
right side of the large digit field. The non-selectable digits are replaced
by standard text, which can be configured while programming. Some examples
of this display format:

SEL59402 :   selcall address 59402 selected
SEL 22   :   selcall address 22 selected (2 digits selectable)
SEL 4AA :   selcall address 4AA selected (includes group digits)
  SEL 02 :   selcall address 02 selected, overlay text ' SEL   '

Portable:
SL is shown in the bottom left-hand corner of the display. By turning the
channel knob the transceiver temporarily switches to Channel mode and
displays either the channel name or channel number.

The selcall address scrolls from right to left and stops when it reaches the
last digit. Since only 4 alphanumeric characters can be seen at any one
time, use the "Display roll" function to scroll the address again. Some
examples of this display format:

SL 9402 :   selcall address 59402 selected (5 not shown on display)
SL   22 :   selcall address 22 selected (2 digit selectable)
SL 4AA :   selcall address 4AA selected (including group digits)

Only numerical digits 0..9, and group digits A..E can be selected for the
selcall address.

3. Both Channel and Selcall readout
This display format is preferred for applications where it is desirable to
display both the channel number and selcall address. In the Optional
features window set the Normal display format parameter to "Both".

Mobile:
The selcall address (up to five digits) is shown on the right of the display
while the channel number (up to three digits) is shown on the left. The two
are separated by a period as shown below.

  1.51234 :   channel 1, selcall address 51234 (5-digit selectable)
116. 1234 :   channel 116, selcall address 51234 (4-digit selectable, 5 not
               shown on display)

Portable:
Four digits of the selcall address are shown in the large section of the
display, and the last two digits of the channel number are shown in the small
two digit section of the display.

Note: While in this mode only numbers are clearly displayed for the channel
name. Some examples of this display format are shown below.

 1 1234:   channel 1, selcall address 51234 (5-digit selectable, 5 not shown
               on display)
16 234:   channel 116 (1 not shown on display), selcall address 1234
               (3-digit selectable, 1 not shown on display)

4.8.2 Status entry mode

The status entry mode operates similar to the selcall entry mode.

Mobile:
Up to 5 digits can be selectable for status number entry. If less than
digits are selectable, an overlay text character will be shown at these
positions. This overlay text is configured while programming the
transceiver.

The status entry digits replace the selcall digits as shown in the formats
described in section 4.8.1. Some examples can be found below:

```
 ST 1235  :    status 1235 selected, no overlay text
STATUS 5  :    status 5 selected, overlay text 'STATUS  '
```

Portable:
Up to 5 characters can be used for the status entry number but only four are
displayed at any one time. If more than 4 characters are used, the fifth
character can be seen using the "Display roll" function.

The status entry characters replace the selcall characters as shown in the
formats described in section 4.8.1. ST is shown in the bottom left-hand
corner of the display. Some examples are shown below.

```
St 1235  :  status 1235 selected
St    5  :  status 5 selected
```

4.8.3 Scan mode

Mobile:
The channel number is replaced by the word 'SCAN' during active scanning, and
is replaced by the actual channel number when stopped. Some examples:

```
SC SCAN .1  :    scanning, scan group 1, scan mode
PS CH122.9  :    stopped on channel 122, scan group 9, scan+priority
PR SCAN .1  :    scanning, scan group 1, priority scan mode
```

Portable:
The channel number is replaced by the word "SCAN" during active scanning and
"SCN" appears above. When a channel is found the "SCAN" changes to the
channel name or channel number and the "P" lights if it is a designated
Priority channel. Some examples are as follows:

```
(SCN)        1 SCAN  :    scan mode, scanning, group 1
(SCN, P)   CH 122    :    scan+priority, stopped on channel 122, group 2
```

4.8.4 Dial number entry mode

This transceiver allows entry of up to 28 characters for transmission of
numerical data as a selcall packet or as DTMF digits. The entry mode for
this is initiated by a so-called encode instruction, triggered by pressing a
key. In this dialing entry mode, the mobile displays five characters on the
right of the display, while the portable displays four. Examples of this
display format include:

```
Mobile:
ATD    2:   dialing string '2' entered
ATD 12234:  dialing string '212234' entered (2 not shown on display)

Portable:
    2 :    dialing string '2' entered
  2234 :   dialing string '12234' entered (1 not shown on display)
```

4.8.5 Queue entry mode

The queue entry mode shows the current selected queue entry. Up to six of
these queue entries are available. If no queue calls are received, or if all
queue entries are erased, the display will show dashes. Otherwise, the
display will show the identity of the other party and the channel number (if
stored).

Mobile:
The following examples show the format of the queue entry mode:

```
 12.  402.1 :   channel 12, identity 402, entry 1
 91.59328.2 :   channel 91, identity 59328, entry 2
  2.  09.1 :    channel 2, identity 09, entry 1
   .  62.1 :    no channel, identity 62, entry 1
   .-----. :    queue empty
```

Portable:
"CALL" is shown in the upper right-hand corner of the display. If more than
4 characters, use the "Display roll" function to scroll them. The following
examples show the format of the queue entry mode:

```
(CALL)  1  402 :   call mode, channel 1, identity 402
(CALL)  1 9328 :   call mode, channel 1, in list, identity 29328
                     (2 not shown on display)
       -- ---- :   queue empty
```

4.8.6 User lock display readout

The user lock function allows transceiver operation to be locked temporarily
by the user. By entering a four-digit PIN (Personal Identity Number), the
transceiver can be unlocked. This user lock status is remembered upon
switching off the transceiver. The following examples show some possible
display formats within this mode:

Mobile:
```
 LOCK 1    :   user lock mode
LOCK --12  :   two digits of the PIN-code are entered
LOCK 1234  :   all four digits are entered
```

Portable:
```
  LOC1 :   user lock mode
    12 :   two digits of the PIN-code are entered
  1234 :   all four digits are entered
```

4.8.7 Scan programming mode

In the scan programming mode, the transceiver user can include and exclude channels in a scan list and assign priority channels.

Mobile:
"ADD" is shown in the upper right-hand corner of the display.

```
           CH  2.9  :    channel 2, scan group 9, not in scan list, no pri.
                          channel
(ADD)      CH  2.8  :    channel 2, scan group 8, in scan list, no pri. channel
(ADD)  PR CH  2.2  :    channel 2, scan group 2, in scan list, pri. channel
```

Portable:
"SCN" is blinking in the upper right-hand corner of the display; "P" and "A" are shown in the middle left-hand side of the display. The display for scan programming has the following format:

```
(SCN)        9   2   :    scan group 9, channel 2, not in scan list,
                            non priority channel
(SCN, A)     8   2   :    scan group 8, channel 2, in scan list,
                            non priority channel
(SCN, P, A)  2   2   :    scan group 2, channel 2, in scan list,
                            priority channel
```

4.8.8 Other display formats

Other display formats and messages include:

Mobile:
```
  TONE       :    single-tone confirmation mode
 LOCK 2      :    remote stun mode
E2P ERROR    :    EEPROM data damaged
SUM ERROR    :    checksum error
COM ERROR    :    communication error
PA xxxxxx    :    public address
 ERROR       :    remote kill mode
-PROGRAM-    :    program mode (FPU)
 NONE CH     :    no CH (channel) data
```

Portable:
```
   TONE   :    single-tone confirmation mode
   LOC2   :    remote stun mode
   ERR2   :    remote kill mode
   ERR3   :    PLL out-of-lock
```

4.9 Miscellaneous functions

The miscellaneous functions within the user interface include the display illumination function, the emergency switch, and the external alert facility.

4.9.1 Display illumination

Mobile:
The backlight for the LCD is continuously on except in the Emergency mode.

Portable:
When not in Emergency mode, the illumination for the LCD is switched on or off by pressing the key programmed with the Lamp on/off function.

4.9.2 Emergency switch

It is possible to define an emergency key or to connect an external emergency switch to the transceiver (mobile only). By pressing this emergency key for a certain period of time, a special emergency encode format is executed, which can contain various facilities such as repeated transmission of a selcall format or live microphone transmission. The period of time before emergency is activated is valid only for Press-functions and the external emergency switch (mobile only).

4.9.3 External alert/transfer function (Mobile only)

The external alert function is available on the mobile as a facility to alert the transceiver user when it is not possible to hear the normal alert beep. This external alert output can control a relay for activating a horn or the lights. It is possible also to initiate a call to another mobile or pager (5-tone or 2-tone).

256 rhythms are available to control the horn or lights, which makes the signal easy to recognize. This external alert/transfer facility can be switched on and off by pressing a key on the mobile. When both facilities are available, this key provides three selections: off, ext.alert and transfer. In order to use the transfer function the "XNOT" instruction must be included in an encode format.

5. OPERATION

In this chapter the operation of all available functions is described.

5.1 Power-on

On power-up, the radio will emit a confidence tone if the control tone is
set. If an error is detected in EEPROM contents, an error message will be
shown.

The initial operating state is partly dependent upon the configuration of the
programmable parameters. These power-on conditions include:

- Startup scan group (group 0 to 9 scan or Disable)
- Startup monitor (open or close)
- Startup encode definition: allows transmission of logon call
- Startup channel number, or last selected channel at power-off
- Keypad operation
        -Channel
        -Selcall
        -Status
        -DTMF
- Normal display format
        -Channel
        -Selcall
        -Both

It is possible to influence the initial operating state further by including
special instructions in a startup encode definition. The parameters
mentioned above are described in the following sections.

5.2 General operation

Operation facilities can be divided into three categories: facilities which
are immediately executed during a very short period of time (e.g. monitor
on/off), facilities of which execution takes a certain amount of time (e.g.
transmitting a selective call) and facilities which activate a special entry
mode.

5.2.1 Parameters related to the user interface

The following parameters are provided to configure the user interface to suit
a particular application, and to allow selection of some basic facilities:

- Lock code
- Control tone
- Warning tone
- Keypad operation
- Normal display format
- Number entry timeout
- Hold delay
- Busy symbol function
- Overlay text channel (Mobile only)
- Overlay text selcall (Mobile only)

- Overlay text status (Mobile only)
- Ext.alert/transfer (Mobile only)
- Busy LED (Portable only)

The four digit "Lock code" parameter allows temporary locking of the transceiver by the user to prevent unauthorized usage. This 4-digit lock code can have any value between 0000 and 9999. By entering an empty string the lock facility can be disabled. See also section 4.8.6 and the description for key function "Code lock".

Parameter "Control tone" allows selection of ON or OFF for control tone.

Parameter "Warning tone" allows selection of ON or OFF for warning tone.

The "Keypad operation" parameter allows selection of the default mode for digit entry. The Selcall mode allows immediate entry of selcall digits, Channel mode allows immediate entry of a channel number (numerical only), Status mode allows immediate entry of status digits and "DTMF" allows immediate entry of digits for DTMF transmission. The display readout mode will also change to the correct format when pressing a digit key to show the entered digits.

The "Normal display format" parameter selects the default display format. These defaults are described in detail in section 4.8.1. The following selections are available: "Channel", "Selcall", and "Both".

The "Number entry timeout" defines the period of time after activation of one of the available entry modes (e.g. selcall address entry, dial number entry) after which the transceiver returns to the idle operating mode, and the default display format is shown again. This parameter value is selectable between 1 and 255 seconds in 1 second steps. When set to 0, this parameter is disabled, so the transceiver will remain in the selected entry mode until a new mode is selected.

The "Hold delay" parameter selects the period of time the key with the Hold-function must be pressed before the function specified in the hold-column is executed. The hold delay value is selectable in 10 ms steps between 0 and 2550 ms.

The "Busy symbol function" parameter selects the function of the busy-symbol on the display. For most applications, selection "Carrier" must be used to indicate to the user of the transceiver that the channel is occupied. For applications such as sub-tone driven repeater systems, it is preferred to activate the busy symbol only when a carrier without QT/DQT or with a wrong QT/DQT is received. This can be selected by choosing "QT/DQT".

Parameter "overlay text channel" defines the text to be shown on non-displayed positions of the channel number in numerical mode. The most frequently used text for this parameter is 'CH-' or 'CH '. In this field, eight ASCII characters can be entered.

Parameter "overlay text selcall" defines the text to be shown on non-selectable digit positions when the selcall entry mode is activated. For example, if two digits are selectable, the left six digits can be displayed as 'SEL   ' to clearly identify the selcall entry mode. In this field, eight ASCII characters can be entered.

Parameter "overlay text status" defines the text to be shown on non-
selectable digit positions when the status entry mode is activated. For
example, if two digits are selectable, the left two digits can be displayed
as 'STATUS' to clearly identify the status entry mode. In this field, eight
ASCII characters can be entered.

Parameter "ext.alert/transfer" selects the available operating modes for
alerting the user of the transceiver when away from the transceiver. Two
applications exist: alerting the user by activating the horn or the lights of
the vehicle or by calling another mobile (transfer) or tone sequence pager
(5-tone as well as 2-tone). "None" allows selection of neither application,
"ext.alert" provides selection of external alert on/off, "transfer" provides
selection of transfer on/off, and parameter selection "ext/trans" provides
selection between off, external alert and transfer.

The "Busy LED" parameter determines the use of the busy LED. For QT/DQT
driven repeater operation selection "QT/DQT" should be used. For all other
applications, selection "Carrier" is preferred. Selection "Disable",
disables this parameter.

5.2.2 Key functions related to the user interface

The following functions are related to the basic operation of the
transceiver:

- Digits 0 to 9
- Alert volume
- Batt check
- Channel ent.
- Clear digit
- Code lock
- Control tone
- Digit 1x
- Digit 10x
- Digit up
- Digit shift
- Ext/transfer (mobile only)
- Hold delay
- Key lock
- Mode reset
- Mode select
- Mon-mute
- Mon-unmute
- Mon-toggle
- Monitoring
- Queue msg
- Queue mode
- Queue next
- Queue Select
- Scan prog
- Selcall ent.
- Status ent.
- Shift on/off
- Warning tone

A more detailed description for some of these key functions is found further

in this section. Some key functions are also described in other sections when they are relevant to other operation facilities, e.g. selcall.

The digits 0 to 9 are used for several purposes. The selcall-related purposes are described in section 5.5.4; channel entry mode operation in section 5.3.1.

The "Alert volume" function changes the level of the alert tone. The two available levels, Low and High, can be adjusted via the Optional features window with the "Alert volume level" parameter (see section 6.5).

The "Batt check" function displays either "FULL", "MED", or "LOW" depending on the current power level of the battery. Note that with NiCd batteries since their output is constant for the majority of the charge the "FULL", "MED", and "LOW" settings are not proportional. With this type of battery the "Batt check" will display "FULL" for the majority of time, and only near the last 10 or 20 minutes of battery life will the display change to "MED" or "LOW".

The "Channel ent." function is related to channel selection, described in section 5.3.2.

The "Clear digit" function is used with many entry modes. For selcall-related entry modes, see the description of this function in section 5.5.4. The operation of the clear-key in the channel entry mode is described in section 5.3.1.

The "Control tone" function is used to toggle the control tone on and off. If the control tone is set a beep will sound when turning the power on or during operations.

The "Code lock" function activates the PIN-code (Personal Identity Number) lock facility. By activating the code lock, the transceiver cannot be used by unauthorized people. When the code lock is activated, the user must enter the appropriate PIN number to unlock the transceiver. If the code is not entered correctly, the transceiver will emit an alert beep, and the user is requested to try again. See section 4.8.6 User lock display readout for a description of the display format.

Functions "Digit 1x", "Digit 10x", "Digit up", "Digit shift", "Mode reset", "Mode select", "selcall ent.", and "Status ent." are all related to the selcall entry mode and described in detail in section 5.5.4.

The "ext/transfer" function is used to toggle the external alert facility and/or transfer facility on and off. See section 4.9.3.

The "Hold delay" function changes the hold delay duration to the value specified for parameter "Hold delay" in the Optional features window. This function is useful to extend the duration of the key hold period for up to 2.55 seconds, e.g. to extend the required time to press an emergency key.

Function "Key lock" locks the channel select, front keys, and top keys for press, hold and release actions (portable) or channel select and mic keys (mobile).

Functions "Mon-mute", "Mon-unmute", "Mon-toggle" and "Monitoring" operate the

squelch monitor. By using these functions, it is possible to monitor a
channel for a short period of time, e.g. to determine if it is possible to
transmit a call. It is possible to link these functions to one key so that
this key causes the transceiver to unmute while it is pressed. This function
is frequently found on other transceivers using a key on the side of the
portable or operated by a key on the microphone. For this kind of operation,
function "Mon-unmute" should be linked to the Press action and function
"Mon.mute" should be attached to the Release action for the same key. This
operation can also be done by simply using the "Monitoring" function.

Functions "Queue msg", "Queue mode", "Queue next" and "Queue select" are
described in detail in section 5.5.4.

A description of function "Scan prog" (scan programming) can be found in
section 5.4.1.

Function "Shift on/off" should be attached to a key on the transceiver. The
Shift-function allows selection of secondary functions by pressing the Shift-
key first, then the key programmed with the desired function. The Shift-
function can be deactivated by pressing the same key again.

"Warning tone" turns the warning tone on or off. The adjusted "Warning tone"
setting is stored in EEPROM so it is remembered at power-off of the
transceiver.

5.2.3 Introduction to the concept of encode and decode formatting

These encode and decode formats are compatible with the TK-709/809/249/349
units; except for some additional functions.

An example of a simple encode format is shown below:

ERRX1 XCARR TXM

The encode format is entered in the programming software as text, then
compiled by the software to instructions which are understood by the
transceiver.

An encode format must be given a name, which is used in other menus within
the programming software to link this encode format to a function, to another
encode format, or to a decode format.

The encode format as shown above is designed to be linked to the PTT-Press
action. A short explanation of this encode format follows:

ERRX1 : This instruction tells the transceiver to emit an error beep when an
          exit instruction causes the interpreter to exit the encode string.
XCARR : This instruction exits the encode format when a carrier is detected,
          and will thus initiate an error beep.
TXM   : If the encode format is continued, this instruction will then switch
          the transceiver to the transmit mode with the microphone enabled.

In the following sections, a comprehensive number of encode instructions are
described, divided into three groups: 5.5 Selective calling, 5.6 QT/DQT, and
5.7 DTMF.

Decode formats are similar to encode formats; however, they are used only for decoding selcall messages. Also included in the following sections is a comprehensive number of instructions available which offer a wide range of capabilities.

5.3 Channel selection

Channel selection, parameters and key functions related to channel selection, and instructions used for transmitting and receiving are described in this section.

5.3.1 Operation of channel selection

Multi-channel models:
Two methods for channel selection are provided: 1. by turning the channel knob, or 2. by decimal entry of the channel number with the optional DTMF keypad.

Channel selection via the channel knob is best suited for selection between a small number of channels. The channel knob allows fast selection of channels without any key press action. Channel readouts which include alphanumeric characters can only be selected with the channel knob. By turning the channel knob clockwise, the following channel will be selected, and by turning the knob counterclockwise, the previous channel will be selected. The channel list is organized as a circular list, so it is possible to pass the first and last channel in the list. By turning the channel knob, the transceiver will automatically abort any entry mode and will be forced to the Channel readout mode.

For decimal entry of a channel, the Channel entry mode must be selected first. Note that the Channel entry mode can also be activated automatically when pressing a numerical key in the idle mode (section 5.2.1). The user is requested to enter three digits. After entry of these digits, the transceiver will check if the channel number is available. If available, the transceiver will switch to that channel, if not, the transceiver will emit an error beep and stay on the current channel. Using the "Clear digit" function, the rightmost digit can be erased and corrected.

Mobile 2-channel:
The channel selector is used to select a channel. Each time this selector is pressed, the transceiver toggles between channel 1 and channel 2.

5.3.2 Parameters and functions related to channel selection

The following parameters are related to channel selection:

Edit/Optional features
- Startup/Channel

[F10] Channel parameters
- Receive frequency
- Transmit frequency
- Frequency shift
- Channel Name

The following function is related to channel selection:

- Channel ent.

The selected channel on startup is configured using the parameter "Channel"
in directory Edit/Optional features/Startup. The default channel number
should be entered. This number can be found in the Channel window or in the
"Ch No." column of the Channel Information window. The valid range is 1 to
250, or "Disable" can be selected. If a non-existing channel number is
selected, channel 1 will be selected on startup. If "Disable" is selected,
the channel last selected will open upon startup. To prevent EEPROM wear-
out, the channel number is stored after a timeout of 5 seconds (important for
selection of the channel number by the channel turn-knob).

The "Receive frequency" parameter selects the receive frequency. This
frequency is entered as a number in MHz. The entered frequency will be
rounded off to the nearest 5.00 or 6.25 kHz divisible frequency, and must fit
in the radio band selected.

The "Transmit frequency" parameter selects the transceiver frequency used for
transmitting speech and signaling information. This frequency is entered as
a number in MHz. The entered frequency will be rounded off to the nearest
5.00 or 6.25 kHz divisible frequency, and must fit in the radio band
selected.

The "Frequency shift" parameter allows you to move the crystal clock
frequency slightly, which may be useful to prevent interference on some radio
channels. When this interference is noticed during operation, set this
parameter to "Yes" for the particular channel.

The "Channel Name" parameter allows manual selection of the channel name.

The "Channel ent." function is related to channel selection and allows manual
selection of the operating channel.

5.3.3 Encode instructions related to channel selection

The following encode instructions are related to the basic channel selection
and receive/transmit switching functions:

- TXS, TXD, TXM, RX, TXP, TXF, RXF
- ERRX0, ERRX1, XCARR, SELCH

Instruction TXS is used to switch to the transmit mode with selcall encode
enabled. It is also used to mute the transmit audio path for a selected
period of time using the DEL instruction. See section 5.5.5 for a detailed
description of the TXS and DEL instructions.

Instruction TXD is used to switch to the transmit mode with DTMF encode
enabled. See section 5.7.2 for a detailed description.

Instruction TXM is used to switch to the transmit mode with the microphone
enabled. This instruction is normally used in encode formats linked to the
PTT Press-function, or within encode formats with live-microphone
transmission included in an emergency call procedure. Also, beeps will be
muted to avoid interference to the transmit path. If you wish to hear the
key-Press or key-Hold beep, insert a DEL instruction before TXM so that the
full beep is executed first.

Instruction RX switches the transceiver from transmit mode to receive mode.
A typical application is for a leadoff delay on PTT-release.

The TXP instruction is similar to the other transmit functions; however, it
does not change the current transmit audio path selection (selcall, DTMF or
microphone). The programmed transmit frequency for the selected channel will
be used.

The TXF instruction can be used to transmit on any valid frequency within the
selected frequency band. This instruction is useful to, for example,
transmit a pager call on a specific frequency. The syntax of this
instruction is TXF 'rf-freq' where "rf-freq" is a valid frequency in MHz
within the selected radio band.

The RXF instruction can be used to switch to receive on any valid frequency
within the selected frequency band. This instruction is useful to, for
example, listen to a response on a specific frequency. The syntax of this
instruction is RXF 'rf-freq' where "rf-freq" is a valid frequency in MHz
within the selected radio band.

The ERRX0 instruction will prevent an error beep from being emitted when the
current encode format is aborted due to an exit command (XCARR).

The ERRX1 instruction will cause an error beep to be emitted when the current
encode format is aborted due to an exit command (XCARR).

Upon execution of XCARR, the transceiver will continue in the encode format
when no carrier is detected, and abort the encode format when a carrier is
detected. This instruction can be used to create a carrier-lockout function.

Instruction SELCH selects a specific radio channel. The syntax of this
instruction is SELCH 'channel' where "channel" specifies the transceiver

channel to be selected in the range of 1 to 250. Note that the preset
channel number, number in the "Ch No." column of the Channel Information
window, should be use and not the channel name..

5.4 Channel scanning

In this section operation of channel scanning, the scan group concept, the
user scan programming facility, and all scan-related parameters are
described.

5.4.1 Operation of channel scanning

The multi-channel models support a wide range of applications for channel
scanning, based on different scan configurations which are selectable for
either the system group or scan group.

Basic scan functions

The basic scan functions include normal scan and priority scan modes. In the
normal scan mode, two or more channels are checked for activity, and when the
scan condition is met on one of these channels, the transceiver will stop on
that channel. In the priority scan mode, the channel selected before
scanning and the Priority channel are monitored alternately.

The normal scan and priority scan modes can also be combined. In this
combined scan mode, the transceiver will scan all channels in the scan list
for activity, and check for activity on the Priority channel when the
transceiver has stopped temporarily on a non-priority channel.

For the normal scan mode, the scan wait time can be selected for each system
group. This allows selection of parameter values which operate reliably with
the selected scan configuration for that system group.

Possible scan configurations include No carrier, Carrier, QT/DQT, Selcall,
Both (QT/DQT+Selcall), Selcall-st, and Both-st (QT/DQT+Selcall-st).

The scan list determines the channels which are included for each scan group.
This scan include flag is selected for each channel by means of the Channel
window [F10]. Also the Priority channel and the priority scan interval are
set separately for each scan group (Edit/Scan information). Note that it is
possible to include a channel in more than one scan group.

Scan dwell facility

The scan dwell facility forces the transceiver to continue scanning when the
channel activity meets the scan condition for a selected period of time. The
time can be selected in the Edit/System parameters window for anywhere from 1
to 255 seconds. This parameter is configured separately for each system
group.

Scan group concept

The transceiver allows programming of up to 10 scan groups (Edit/ Scan
information). Each of the scan groups has its own Priority channel,
Preference channel, Look back time A, Look back time B, and User program
flag.

Because it is possible to include any channel within a scan list, it is
possible to scan for different conditions, as specified for each system
group, within one scan group. For example, a scan list can contain channels
01, 02, 05, 08, 09 and 10 where channels 01, 02 and 05 are checked for
carrier activity, channel 08 and 09 for selcall 1st tone detection, and
channel 10 for sub-audible tone activity (QT or DQT).

Because the scan list flags are configured for each channel, the maximum
number of channels within a scan group is limited only by the maximum number
of channels. For example, if 210 channels are configured, it is possible to
include all channels in the scan group.

Selection of the scan group is possible by pressing one of the digit keys
while scanning. The matching scan group, numbered from 0 to 9, is then
selected.

Behavior of PTT while scanning

The behavior of the Push-To-Talk switch can be configured in a number of ways
for use in scanning systems. Some examples follow:

- When scanning, the PTT-switch is ignored and if pushed an error beep
  emitted
- When scanning, pressing the PTT-switch will cause an error beep to be
  emitted, and the transceiver will cancel channel scanning
- When pressing the PTT-switch while scanning, the transceiver will transmit
  on the channel it is waiting on; if it is not waiting on a channel
  transmit on the Preference channel
- When pressing the PTT-switch while scanning, the transceiver will always
  transmit on the Preference channel

User scan programming

The user scan programming facility allows the user of the transceiver to
include or exclude channels for the selected scan group, and to assign the
Priority channel to one of the available channels. A separate user interface
is provided for this facility. The display format is described in section
4.8.7. Scan programming is possible only from the optional KDM-7 DTMF
keypad. The functions of the keys within the user scan programming mode are
fixed as described in the table below.

```
Key     |Function
---------------------------------------------
0..9    |enter scan group
*       |include/exclude channel in scan list
#       |assign/reset Priority channel
hold-0  |exit scan programming mode
encoder |select channel
```

5.4.2 Parameters and functions related to channel scanning

To configure the modes described, the following parameters are provided:

Edit/Optional features/
- Start up/Scan

Edit/sYstem parameters
- Drop out delay time
- Scan dwell time
- Tx dwell time
- Scan configuration

Edit/Scan information
- Priority channel
- Preference channel
- Look back time A
- Look back time B
- User program

[F10] Channel parameters
- Scan include list

Edit/Panel key assignment/[F2] key list (mobile)
Edit/Top/side key assignment/[F2] Key list (portable)
- Scan on/off
- Pri on/off
- Scan+Pri
- Scan on
- Pri on
- Scan+Pri on
- Scan prog

Parameter "Start up/Scan" determines if channel scanning is activated when
switching on the transceiver. Set this parameter to any number from 0 to 9,
depending on the scan group you wish to scan upon startup. If set to "Back
up" the transceiver will remember the last condition of Scan and upon Start
up continue at that point. If scan was not active at power off, "Back up"
will not start scanning upon power on.

The "Drop out delay time" parameter selects the period of time the
transceiver keeps waiting on a channel after the scan stop condition is
removed. The value of this parameter is selectable between 0.5 sec and 15.0
sec in 0.5 sec steps.

The "TX dwell time" parameter selects the period of time for scan to resume
after a transmission is completed and the correct signal drops out. The
value of this parameter is selectable between 0.5 sec and 15.0 sec in 0.5 sec
steps.

The "Scan dwell time" parameter selects the period of time after which
scanning is forced to restart on a channel where the scan stop condition
applies. Selectable in 1 second units between 1 and 255 seconds. This scan
dwell feature is disabled by selecting "Off".

Parameter "Scan configuration" selects the scan wait condition. If "Carrier" is selected, the transceiver stops on a channel when a carrier is received on that channel (noise squelch operated). Using selection "QT/DQT", the transceiver stops on a channel when a valid QT or DQT tone is received on the channel. Selection "Selcall" causes the transceiver to stop on a channel when the tone is matched to the first tone of the "Primary Rx address". "QT/DQT" and "Selcall" scanning are combined in the "Both" scanning configuration. "Selcall-st" is similar to selection "Selcall", but also causes the transceiver to stop when the selcall monitor is open. Selection "Both-st" is similar to "Both", but also causes the transceiver to stop when the selcall monitor is open. The "No-carrier" scan condition stops on a channel when no carrier is detected on that channel. Note that for QT/DQT-operated scan configurations (QT/DQT, Both and Both-st), the QT/DQT condition will be replaced by carrier detect when no QT/DQT decode is assigned for the channel.

One "Priority channel" is available per scan group. The Priority channel facility is normally used to 'watch' activity on an important channel. Sensing of the Priority channel is possible during scanning, when listening to another channel, or during a conversation on another channel. For the Priority channel the preset channel number should be used, which can be found in the "Ch No." column of the Channel Information window.

The "Preference channel" parameter selects a special channel, which can be used for different purposes in the scan mode. In most applications, this Preference channel is used for transmission of speech when the PTT switch is pressed during scanning. See also the description of encode definitions PREFA and PREFS (next section). For the Preference channel the preset channel number should be used, which can be found in the "Ch No." column of the Channel Information window.

The Priority channel and flags for each channel pointing to a scan group can be changed by the user of the transceiver. For this purpose, a scan programming mode is defined. Whether or not this user programming mode is activated can be configured for each scan group by selecting "Enable" or "Disable" to the parameter "User program".

For each of the ten scan groups, a scan include flag is defined for all channels. This enables assigning of any number of channels to a single scan group. Please keep in mind that the scan process will be disturbed by assigning too many channels to a scan group because of the long duration of the scan turn around time. These include flags are organized per channel via parameter "Scan include list".

Function "Scan on/off" allows the user to toggle channel scanning on and off using a single key. Using function "pri on/off", the user is able to toggle priority scan on and off by pressing a single key. Normal scan and priority scan can be simultaneously toggled on and off with the "scan+pri".

The non-toggle functions available for all of the above mentioned toggle functions are "Scan on", "Pri on" and "Scan+pri on".

5.4.3 Encode instructions related to channel scanning

The following encode instructions are related to channel scanning:

- STOPS, STOPP, STRTP, STRTS
- PREFA, PREFS, SPREV
- XSCAN, XPRI, XSENS
- SELSC

Instruction STOPS cancels the channel scanning mode if active. This
instruction can be used in encode formats to cancel scanning modes before
transmitting speech or a call.

Instruction STOPP cancels the priority scan mode if active. Also this
instruction is frequently used in encode formats to cancel scanning modes
before transmitting.

Instruction STRTP switches on Priority scanning.

Instruction STRTS switches on scanning.

Instruction PREFA selects the Preference channel in the channel scanning
mode, both when scanning and when waiting on a scan channel. This
instruction is ignored when channel scanning is not activated.

Instruction PREFS selects the Preference channel in the channel scanning
mode, but only when not temporarily stopped on a channel. This instruction
is ignored when channel scanning is not activated, or when the transceiver is
waiting on a scan channel.

Instruction SPREV selects the previous manually selected channel. By using
this instruction, the channel number last used is selected, e.g. when
scanning is canceled before transmitting speech or a call.

Instruction XSCAN quits the currently executing encode format when the normal
scan mode is activated, with or without an error beep (see instructions ERRX0
and ERRX1). If not scanning, the XSCAN instruction is ignored.

Instruction XPRI quits the currently executing encode format when the
priority scan mode is activated, with or without an error beep (see
instructions ERRX0 and ERRX1). If priority scanning is not active, this
instruction is ignored.

Instruction XSENS quits the currently executing encode format when scanning
is activated, and the transceiver is not waiting on a channel, with or
without an error beep (see instructions ERRX0 and ERRX1). This instruction
is ignored if the transceiver is not scanning or when the transceiver is
waiting on a channel while scanning.

Instruction SELSC selects a specific scan group, or selects the next or
previous available scan group. The syntax of this instruction is SELSC
'scangr'. The valid range for "scangr" is 0 to 9 for direct scan group
selection, UP for next scan group selection and DOWN for selection of the
previous scan group.

Some examples of encode formats using the encode instructions:

- ERRX1 XSCAN TXM
If scanning is activated, this encode format is canceled and an error beep is emitted. When scanning is not active, the transceiver is switched to the transmit mode with the microphone enabled.

- ERRX1 STOPS STOPP XSCAN XPRI TXM
Exits with error beep when either normal scan or priority scan is activated. Before quitting this encode format, both normal scan and priority scan are switched off   Note that the XSCAN and XPRI instructions check the state at the time the encode format is started. If both normal and priority scan were inactive when executing this encode format, the transmitter will be activated with the microphone enabled.

- PREFS TXM
While scanning and not waiting on a channel, the Preference channel will be selected. TXM switches on the transceiver with the speech path enabled.

5.5 Selective calling

The transceivers offer a comprehensive set of selective call (selcall) facilities. These facilities range from transmitting and receiving simple 5-tone calls to operation within advanced selcall operated Trunked radio systems.

5.5.1 Introduction to selcall

Selective calling allows transceivers to be called individually or within a group by transmitting a sequence of short tones within the AF-range (typically 800 to 3000 Hz). Basic 5-tone selcall applications are found around the world, but primarily in Europe and Australia. Based on the 5-tone selcall standard, many system solutions have been developed by manufacturers. These solutions range from smart solutions for group calling, automatic-close and status transmission to sophisticated Trunked radio systems.

Because every manufacturer has defined its own standard, it is virtually impossible to support them all. The concept of this transceiver, however, offers a method to build signaling formats which can emulate operation in most of these systems.

5.5.2 Selcall applications

As noted before, a wide range of applications can be supported by selective calling systems. In this section a number of important selcall applications are explained.

Transmit & receive 5-tone

The most basic operation of selcall is to transmit and receive calls in the standard 5-tone format. In most radio networks, a part of this 5-tone is fixed and the other digits are selectable. When the user of transceiver A wants to speak to the user of transceiver B, he or she selects the identity of transceiver B, and presses the call key. A 5-tone selcall message is transmitted, received by transceiver B, decoded, and if the identity matches, transceiver B will emit an alert tone and unmute. It is possible now to start a conversation.

For transmitting a standard call, the transceiver must at least be equipped with a call key. If selection of another party is required (it is also possible to allow calls to one transceiver address only, e.g. to a dispatcher), the transceiver must have up/down keys for the selectable digits or a keypad to enter the identity of another party. To allow monitoring of the channel before a call is transmitted, most transceiver units offer a monitor or open/close key.

When receiving a valid call, the transceiver automatically unmutes. To close the transceiver after finishing the conversation, the monitor or open/close key is operated by both parties to mute the transceivers.

The 5-tone format allows division of transceivers into groups. The size of the user group can vary by assigning more or less selectable digits. Normally the rightmost digits in the 5-tone format are selectable, and the digits on the left are fixed. For example, a fleet of 100 users occupies identities between 59400 and 59499, and a fleet of 10000 users occupies the numbers between 40000 and 49999. By restricting the number of selectable digits, the user cannot call transceivers within another fleet.

Group calls

Group calls are used to announce a message to several users simultaneously or when a conversation is requested between multiple users. The most widely used group calling system is the so-called A-digit group calling system. This group calling algorithm allows any digit to be replaced by a group digit, so that all units matching the 5-tone excluding the position(s) of the A-tone will be called.

For example, all transceivers with identity 59400 to 59409 can be called simultaneously by transmitting 5940A; all transceivers numbered from 59400 to 59499 can be called by transmitting 594AA. It is possible also to assign A-digits on other positions within the 5-tone address, e.g. 594A2 so that transceiver 59402, 59412, 59422, 59432 and so on are called.

Another common standard uses the 0-digit as group tone instead of the A-digit. Because most mobile and portable transceivers cannot transmit A-tones but can transmit 0 tones, this facility also allows mobile users to transmit group calls. For systems using the A-tone instead, this is normally possible

only on the fixed station transceiver. A disadvantage of this system is the reduced number of addresses in the radio network (9 instead of 10 values per digit).

In some systems, a group tone is always transmitted in a fixed position of the 5-tone format and uses a longer tone to allow the decoder sufficient time to decode a tone other than expected. This prolonged A-tone group tone format is frequently used in Australia.

It is also possible to create user groups using multiple decode identities. The transceiver will regard a matching call, except for the primary address, as a group call. The advantage of this solution is the flexible size of such a group, because it can contain any number of users, ranging from 2 to all units.

The transceivers support all group call facilities as explained above.

Repeat tone

In almost all selcall standards a repeat tone is defined. This repeat tone is transmitted in a position within the sequence where the digit is the same as previously transmitted. By using a repeat tone, a sequence cannot include a single tone with the duration of multiple tones, which could be decoded as a single digit instead. For the repeat tone, digit value E is normally assigned. Some examples of sequences which include repeat tones:

- sequence 59422 becomes 5942E
- sequence 59444 becomes 594E4
- sequence 59902 becomes 59E02
- sequence 55555 becomes 5E5E5

Remote-close

In addition to unmuting the transceiver automatically after receiving a call, it is also possible in some systems to remotely close a transceiver. Such a remote-close call is normally transmitted by the dispatcher to close one or more transceiver units after finishing a conversation.

The widely used PYE/Philips remote-close standard uses an extra 6th C-digit in addition to the standard 5-tone sequence to close one or more transceiver units. For the first 5 tones the same rules apply as previously explained, so it is also possible to include group digits and repeat digits. For example, to remotely close transceiver 59402, sequence 59402C should be sent, and to close all transceivers belonging to fleet 594xx, sequence 594AEC should be sent.

Another method of implementing remote-close is to use another separate 5-tone address as a remote-close address. This can be an individual address (e.g. transceiver 59402 uses address 59452 as remote-close) or an address used by multiple transceiver units (e.g. units 59402, 59403 and 59404 all use 59499 as remote-close). An advantage of this method is that standard 5-tone equipped transceivers can also be used to transmit a remote-close. This remote-close method is frequently used in Motorola transceivers and systems.

Other remote-close formats include the PYE/Philips 9-tone format with a separate status digit value for remote-close. All formats described can be emulated by the software of the transceivers.

Auto-close

The auto-close facility causes a transceiver to close automatically after receiving a non-matching selective call. So, if a dispatcher calls a particular transceiver unit, all other transceiver units receiving the 5-tone sequence will immediately close.

To prevent any 5-tone from being decoded as an auto-close, including calls received from transceivers and dispatchers of other fleets, most transceivers equipped with auto-close will only process calls with addresses belonging to their own fleet. For example, if a fleet uses all identities between 59400 and 59499, the transceivers in that fleet will auto-close only after receiving 594. When the received call matches the identity of the transceiver, it will alert and open again.

These transceivers also offer auto-close, which is supported by a number of additional features to improve operation of this facility.

Status call

A status call facility is also often found in selective call based systems and transceivers. Selcall has some advantages over data when transferring small messages. These advantages include reliable operation when the radio connection is poor, and less signaling overhead compared to data (no preamble and sync message needed).

A frequently used format is the 6-digit status transmission, where the first five tones identify the transceiver unit, and the 6th tone is used to transfer the status digit. In this format 10 states can be transferred, without additional error checking.

When more than 10 different status messages need to be transferred, the 5-tone message can be extended with two or more status digits. If protection is needed against false decoding, a checksum digit could be added.

Also for status calling, the transceiver can be configured for almost any application.

Emergency call

A large number of different formats for emergency calling, based on selective call standards, are in use worldwide. Almost every manufacturer has specified their own standard.

An emergency call format frequently used in Europe is the PYE/Philips 6th C-tone format, which thus is identical to the PYE/Philips remote-close format. When an emergency key is pressed, the transceiver will transmit its own 5-tone identity plus C-tone, e.g. transceiver 59402 will transmit 59402C. The identity will be decoded on the base station console, so the dispatcher is able to take appropriate action.

In some systems, this 6-tone format is followed by a period of say 10 seconds live speech transmission, without the need for the user of the mobile or portable transceiver to press the PTT switch. This allows the dispatcher to listen to what is happening. If required, such a call plus live microphone period can be repeated until a reset call is received from the dispatcher (same 6-tone format).

Other systems include the Bosch emergency call format, which uses a repeated single-tone while the live speech message is transmitted.

The number of different standards for emergency calling is quite extensive, and only a few of them are published by the manufacturer. Most of them can, however, be emulated by the transceivers, including the more complicated repeated call plus live speech format.

Who-has-called (WHC)

The who-has-called facility allows a user of a transceiver to retrieve the identity of the other party which has previously called. In some transceivers, it is possible to store more than one calling identity.

A frequently used format for WHC is the 2*5-tone (2-by-5-tone) format, which uses two successive 5-tone messages. The first 5-tone is the selected address, and thus opens the called transceiver, and the second 5-tone is the identity of the calling transceiver. The gap between the two successive 5-tone sequences is around 200 to 300 ms. For example, if the user of transceiver 59402 calls transceiver 59435, then 59435F59402 is transmitted by transceiver 59402; the F-digit identifies the so-called inter-sequence gap. Transceiver 59435 will then show on the display the identity of the calling transceiver.

Another WHC standard uses a 7-tone format. The first 5 tones identify the transceiver to be called, and the two tones immediately following identify the two last digits of the calling party. For example, if the user of transceiver 59402 calls transceiver 59435, then 5943502 is transmitted. Because the fixed digits are the same within the fleet, these digits are added and eventually shown on the display for call-back.

Also for WHC, many manufacturer-specific systems are in use. The transceivers support the mentioned standards, but can also be configured to emulate others. In addition to remembering four WHC identities, the transceivers can also transfer a stored identity to the calling register for automatic call-back.

Free-dialing using selcall

In some systems the PMR base station is connected to a PABX or PSTN via a telephone interconnect unit. Simple systems use DTMF signaling for dialing into a PABX/PSTN network, but there are also systems installed worldwide, which use 5-tone formats for dialing. In addition to translating standard 5-tone calls into pre-defined PABX/PSTN numbers, it is also possible in some systems to transfer a free-dial telephone number.

Additional length identifiers and checksum digits are included to protect the message against false decoding. An example of this sequence, transmitted by transceiver 59492 if number 0528063355 is dialed, is: 59492705280633555. The

6th digit (value 7) is calculated as the total-length modulo 10 (17 MOD 10), and the last 17th digit (value 5) is calculated as the sum-of-all-digits modulo 10 (75 MOD 10).

Because some transceivers can find within such a message their own 5-tone identity they will alert. To avoid this situation a so-called transparency mode is introduced. This transparency mode uses D-digits inserted at any fifth position within the dialing string. Sequence 59492705280633555 therefore becomes 59492D7052D8063D3555. The D-digits are not included in the checksum and length calculation.

This format, and also formats to control other telephone interconnect systems, are supported by the transceivers. Any telephone number of length between 0 and 28 digits can be entered, edited and transmitted.

Remote control functions

Selective call sequences can also be used to remotely operate miscellaneous functions of a transceiver unit. For example, remote stun and revive are used in some mobile and portable transceivers to prevent operation of a transceiver when it is stolen, lost or when the rent is not paid by the user. Remote kill is a function to prevent unauthorized use in security-sensitive areas (police, military). Because the remote control functions should not be interpreted too easily by the receiving unit to prevent false decoding, normally a more complicated format is used for these functions.

It is recommended to use at least multiple successive sequences, for example 5-tone plus 7-tone. A possible format could consist of the 5-tone address of the called unit, an inter-sequence gap of 300 ms, and a 7-tone special sequence consisting of a unique 5-digit sequence, a control digit and a checksum digit. For example, the following formats could be defined for remotely controlling transceiver 59402:

- Remote stun: 59402F3425116
- Remote revive: 59402F3425127
- Remote kill: 59402F3425138

In the example above the 6th digit of the second 7-tone sequence identifies the remote control command (1=stun, 2=revive, 3=kill) and the 7th digit is the checksum digit of the preceding 6 digits.

In addition to the proposed standard explained above, it is also possible to configure the software of these transceivers for other standards in use.

Single-tone

The single-tone (or long-tone) capability is frequently used to control repeater stations, or to open or close a group of transceivers in older selcall based systems.

Repeater stations operated by a single-tone can be activated by transmitting a tone of a specific length with a specific frequency, e.g. a tone of 1400 Hz for 1 second. After receiving this single-tone, the repeater stays activated when a carrier is received from either party. The repeater will fall back to standby after a certain timeout.

Older selcall-based transceivers did not have the capability to decode group calls or all-calls. To overcome this problem, an additional filter and decoder were built in to decode single-tones, also with a specific frequency and tone duration. If such a tone is received by the transceiver, it will open and the transceiver will emit an alert tone. The same principle is possible for remote-close. Earlier Bosch and Ascom transceivers were equipped with this facility.

The transceivers offer single-tone transmission of any tone between 300 and 3000 Hz with any duration between 1 and 7000 ms in 1 ms steps. Also multiple single-tone encodes can be defined. This covers almost every application for single-tone.

In addition, the single-tone facility can be used to transmit calls to fixed addresses of 2-tone pagers according to Motorola and GE standards, frequently used in the United States.

5.5.3 Parameters related to selcall

To configure the transceiver for all applications as previously described, a large number of programmable parameters and encode/decode instructions are provided. These can be entered, edited, compiled and stored in the transceiver using the programming software package.

The parameters related to selcall are described in this section. The key definitions, encode format instructions and decode format instructions are described in the following sections.

A comprehensive list of selcall-related parameters is given below:

Optional features/
- Start del. required
- Digit entry method
- Copy from default tx
- Startup/
  - Encode def.
  - Monitor

sYstem parameters/
- Selcall toneset standard
- Receive gap period
- Selectable selcall digits
- Selectable status digits
- Automatic close
- Monitor function
- Group digit selectable
- System formats/
  - Decode format
  - Encode button #1 (default: normal call)
  - Encode button #2 (default: free-dial selcall)
  - Encode button #3 (default: free-dial DTMF)
  - Encode button #4 (default: single-tone)
  - Encode button #5 (default: status call)
  - Encode button #6 (default: emergency call)
  - Encode PTT-press
  - Encode PTT-release

- Encode DTMF overdial
- Encode DTMF direct
- Encode channel select
- Encode on hook
- Encode off hook

Related channel parameters [F10]/
- Default Tx address
- Primary Rx address
- Secondary Rx address
- Third Rx address

The "Start del. required" parameter selects whether or not a period of no-tone is required at the beginning of a selcall message. If set to "Enable", the message must match exactly with the sequence in the decode definition. If set to "Disable", a maximum of 3 preceding digits are allowed in a message which otherwise matches the sequence in the decode definition.

The "Digit entry method" parameter offers two procedures to enter and change the keypad selectable digits. For a small number of selectable digits (1 or 2 digits), it is most convenient to overwrite the default selcall address. For more selectable digits (3, 4 or 5), it is preferred to overwrite the previously entered selcall address. The first method is referred to as "Replace" and the second method as "Overwrite".

The "Copy from default tx" parameter selects whether or not the selectable digits are overwritten by the channel-related Default Tx address when selecting another channel. If set to "Enable", the selectable digits are overwritten; if set to "Disable" the selectable digits will not change.

The "Encode def." parameter allows a selective call sequence to be transmitted upon power-on. It is possible to include instructions for transmit-lockout, QT/DQT encode, single-tone and so on. See section 5.5.5 for a more detailed description of encode instructions.

The "Monitor" parameter determines if the selcall and/or QT/DQT mute function is initially open or closed after switching on the transceiver. If set to "Enable", mute will open upon startup, and when set to "Disable", mute will stay closed upon startup. Note that the "Monitor function" parameter controls what will open upon startup. See below for an explanation of the "Monitor function" parameter.

The toneset standard for receiving selcall messages is selected in the
"Selcall toneset standard" field. At maximum, 12 tonesets are available, of
which 11 are standard and 1 (KENWOOD) is optional. The standard tonesets
supported are:

- ZVEI   Germany, Austria, Italy, Netherlands, Belgium
- CCIR   United Kingdom, France, Sweden, Norway, Finland, Italy
- EEA   United Kingdom
- PZVEI   Philips derivative of ZVEI
- DZVEI   Germany
- PCCIR   Philips derivative of CCIR
- PDZVEI   Philips derivative of DZVEI
- ZVEI-2   Australia
- EIA   France, United States, Australia
- Natel   Switzerland, Sweden, Norway
- AP-369   Denmark, Sweden

Note that this parameter only selects the toneset standard for decoding. For
encoding, the appropriate encode instructions must be used to select a
specific toneset. The selcall standard parameter is selectable for each
system group.

The "Receive gap period" parameter selects the period of time the selcall
decode algorithm requires a 'no-tone' condition after the last valid tone of
a selective call tone sequence has been received. Normally this value is set
to 1.5 times the duration per tone. So for CCIR 100 ms, this value is set to
150 ms. This parameter is selectable in 5 ms units between 0 and 640 ms.
The receive gap period is selectable for each system group.

The parameter "Selectable selcall digits" selects the number of digits which
can be changed by the user via the keypad or up/down keys. These selectable
digits are normally included in the selcall transmit encode definition.
Possible values are: "None", "One", "Two", "Three", "Four" and "Five".
Because this parameter can be set separately for each system group, it is
possible to use different settings for different applications within one
transceiver.

The parameter "Selectable status digits" selects the number of digits which
can be changed by the user via the keypad or up/down keys, to be used for
status calls. These selectable digits are normally included in the encode
definition for status calls. Possible values are: "None", "One", "Two",
"Three", "Four" and "Five". Because this parameter can be set separately for
each system group, it is possible to use different settings for different
applications within one transceiver.

The "Automatic close" parameter determines the number of digits from the
start of the sequence that have to match the primary receive address in order
to close the portable. When "None" is selected, the automatic close facility
is disabled. Other values are: "Two", "Three" and "Four".

The "Monitor function" parameter defines the use of the "Monitor" function
(5.5.4) for each system group. This parameter also defines the use of the
"Startup/Monitor" parameter (see above). The following selections are
possible: "Disable", "Selcall", "QT/DQT", "Both" and "Reset". When "Disable"
is selected, monitoring is not possible for selcall or QT/DQT. If "Selcall"
is chosen, it is only possible to manually bypass the selcall mute function

(also called open/close). When "QT/DQT" is used, it is only possible to
bypass the QT/DQT mute function. When "Both" is selected, the "Monitor"
function (5.5.4) toggles between Selcall and QT/DQT simultaneously. When
"Reset" is selected the "Monitor" function works as a reset switch, muting
the transceiver.

The "Group digit selectable" parameter determines if group digit selection is
possible using the Digit 1x, Digit 10x and Digit Up key functions ("Enable")
or if group digit selection is not allowed ("Disable").

For each system group one decode format can be selected. A decode format
contains instructions to check for incoming call and selcall-driven
facilities such as remote-close, remote stun, secondary address group calls
etc. The decode format will be executed when a full sequence of selcall
digits has been received. See section 5.5.6 for further details on decode
formats.

For each system group encode formats can be selected. These encode formats
are linked to key definitions or are triggered by certain conditions. The
following system-group related encode format entries are available:

- Encode button #1 (default: normal call)
- Encode button #2 (default: free-dial selcall)
- Encode button #3 (default: free-dial DTMF)
- Encode button #4 (default: single-tone)
- Encode button #5 (default: status call)
- Encode button #6 (default: emergency call)
- Encode PTT-press
- Encode PTT-release
- Encode DTMF overdial
- Encode DTMF direct
- Encode channel select
- Encode on hook (Mobile only)
- Encode off hook (Mobile only)

For each of these format entries, one of the separately defined encode
formats can be selected. See section 5.5.5 and 5.5.6 for further details on
encode and decode formats. In section 5.5.4, the key definitions linked to
the entries 'Encode button #1' to 'Encode button #6' are explained.

The format selection for "Encode PTT-press" is intended for applications such
as transmit lockout, QT/DQT selection and transmitting an identity message on
every PTT press. The "Encode PTT-release" format selection can be used for
QT/DQT trailing noise suppression and identity message on PTT-release. The
"Encode DTMF overdial" format will be executed each time a key is pressed on
the keypad while the PTT switch is pressed. The "Encode channel select"
format will be executed on selection of a channel which refers to this system
group. This encode format will be executed for manual selection of the
channel as well as while scanning.

If a decode or encode format is not required for one or more of the
parameters explained, selection [Disable] can be entered.

Four 5-digit selcall addresses are available for each channel. This allows
programming of selcall identities on a per-channel basis. Although the
application is fully defined by the programmed encode and decode formats, the

default assignment for these selcall addresses are:

- Default Tx address
- Primary Rx address
- Secondary Rx address
- Third Rx address

The "Default Tx address" is used to assign the default values of the user
selectable digits. Depending on the status of the "Copy from default tx"
parameter, the contents of this address are copied to the selectable selcall
digits on power-up only or upon any channel change. The Default Tx address
is also copied to the selectable address digits when a new identity is
entered and "Digit entry method" is set to "Replace". These address digits
can be accessed in any encode or decode format by using the ^D pointer; see
section 5.5.5.

The "Primary Rx address" is used normally to define the individual identity
of the transceiver being used. In addition, these five digits are used for
the Automatic-close facility (matching of an incoming sequence to the Primary
Rx address), and the first digit is also used for 1st-tone selcall scanning.
The digits of the Primary Rx address can be accessed from within any encode
or decode format by using the ^P pointer; see section 5.5.5 for further
details.

The "Secondary Rx address" is used normally to define a second receive
identity. In most applications, this secondary rx identity is handled as a
group call. The first digit is also used for 1st-tone selcall scanning. The
digits of the Secondary Rx address can be accessed from within any encode or
decode format by using the ^S pointer character; see section 5.5.5 for
further details.

The "Third Rx address" is used as a third receive address in most
applications. However, this five-digit selcall address field can also be
used for other purposes. These digits can be accessed from within any encode
and decode format by using the ^T pointer character; see section 5.5.5 for
further details.

5.5.4 Key functions related to selcall

For selcall applications a number of key functions are provided. Note that
some of these functions are also used for other purposes, e.g. digits 0..9
and "Monitor". The following functions are related to selcall:

- Digits 0..9
- Clear all
- Clear digit
- Digit 1x
- Digit 10x
- Digit up
- Digit shift
- Encode #1 (default: normal call)
- Encode #2 (default: free-dial selcall)
- Encode #3 (default: free-dial DTMF)
- Encode #4 (default: single-tone)
- Encode #5 (default: status call)
- Encode #6 (default: emergency call)

- Group digit
- Mode reset
- Mode select
- Monitor
- Mon-selcall
- Mon-QT/DQT
- Queue msg
- Queue mode
- Queue next
- Queue Select
- Selcall ent.
- Status ent.

Digits 0..9 are used for the following purposes in selcall applications:

- Entry of selcall address
- Entry of status number
- Entry of free-dial number
- Selection of a queue entry

Both the selectable number of digits for the selcall address and status number can be configured from 0 to 5. The size of the free-dial number can vary from 0 to 28 digits. This free-dial number can be entered and edited before the call is transmitted.

The "Clear all" function operates in the queue mode and free-dial entry mode. In the free-dial entry mode it will erase the full number. This function is normally attached to Shift-C.

By executing the "Clear digit" function in the selcall mode, the selectable digits will be initialized to the Default Tx address. In the status number entry mode, the "Clear digit" function will reset all status digits to 0. In the free-dial entry mode, the "Clear digit" function will erase the latest entered digit. This function is normally attached to the C-key on the optional DTMF keypad.

The "Digit 1x" function increments the 5th digit of the selectable selcall address or the 5th digit of the status number, depending on which entry mode is selected. If neither the selcall entry mode nor the status entry mode is active, the selcall entry mode will be activated when pressing the key programmed with this function.

The "Digit 10x" function increments the 4th digit of the selectable selcall address or the 4th digit of the status number, depending on which entry mode is selected. If neither the selcall entry mode nor the status entry mode is active, the selcall entry mode will be activated when pressing the key programmed with this function.

The "Digit up" function increments the currently selected digit of the selectable selcall address or the currently selected digit of the status number, depending on which entry mode is selected. The flashing digit indicates the currently selectable digit. If neither the selcall entry mode nor the status entry mode is active, or the digit selection mode (indicated by the flashing digit) is inactive, pressing the key programmed with this function will emit an error beep.

The "Digit shift" function selects the next digit of the selectable part of
the selcall address or status number. The selectable digit is shifted from
right to left each time this function is executed. The flashing digit
indicates which digit is currently selected. If neither the selcall entry
mode nor the status entry mode is active, or the digit selection mode
(indicated by the flashing digit) is inactive, pressing the key programmed
with this function will select the rightmost digit of the selcall address.

The six available "Encode #1..#6" functions are linked to the six system-
group related encode formats (Encode buttons #1..#6). These six call formats
and the default functions attached to them are listed above.

The "Group digit" can be used only in the selcall address entry mode. It
will enter an A-digit at the selected position. When no entry mode is
selected, executing the "Group digit" function will automatically select the
selcall entry mode, provided that one or more digits are selectable;
otherwise, an error beep will be emitted. The "Group digit" is normally
attached to Shift-A (Shift action, A-key).

The "Mode reset" function switches the transceiver to the idle status. The
display will show the default display format.

The "Mode select" function switches between the two most frequently used
entry modes; channel entry and selcall entry. If no mode is selected, the
non-default display mode will be selected. If the channel number is normally
visible, upon pushing the key programmed with the "Mode select" function, the
selcall entry mode will be selected. From within the queue entry mode, it
will copy the selcall and channel information from the currently selected
queue entry and allow editing by the user. From within any other operating
mode, this function will not operate.

The "Monitor" function toggles both Selcall and QT/DQT mute between open and
close depending on the "Monitor function" parameter setting (5.5.3). If the
"Monitor function" parameter is set to "Both" the table below can be used to
determine the status after executing this function.

```
        Before                    After
Selcall close, QT/DQT close |Selcall open, QT/DQT open
Selcall close, QT/DQT open  |Selcall open, QT/DQT open
Selcall open, QT/DQT close  |Selcall close, QT/DQT close
Selcall open, QT/DQT open   |Selcall close, QT/DQT close
Selcall close, no QT/DQT     |Selcall open
Selcall open, no QT/DQT      |Selcall close
QT/DQT close, no selcall     |QT/DQT open
QT/DQT open, no selcall      |QT/DQT close
```

The "Mon-selcall" function is used to toggle the selcall mute between open
and close. It will not affect the QT/DQT monitor status. Normally this
function is attached to the #-key on the optional DTMF keypad.

The "Mon-QT/DQT" function is used to toggle QT/DQT mute between open and
close.

While in queue mode, the "Queue msg" function toggles between the queue (who
has called) and status.

The "Queue mode" function activates the queue readout mode. The display
format for the queue readout mode is explained in section 4.8.5. By pressing
a key (1..9), the appropriate queue entry will be selected.

The "Queue next" function selects the next available queue entry in the
queue. If the queue mode was not activated before, the "Queue next" function
selects the queue readout mode first and the first entry will appear on the
display. If the last entry is passed, the first entry will appear again.

The "Queue Select" function selects the next available queue entry in the
queue, or selects the default operation mode when the last queue entry is
passed. If the queue mode was not activated before, the queue readout mode
will be selected with the first entry shown.

It is possible to transmit a call from within the queue mode and have the
selectable digits copied from the queue entry. It is also possible to
transfer the selcall identity to the selectable address register and leave
the queue using the "Mode select" function. Function "Clear digit" will
erase the current selected queue entry. Function "Clear all" erases all
queue entries.

The "Selcall ent." function allows editing of the selectable address digits.
These digits can be used in encode formats to define transmit selcall
messages. Depending on the system-group related "Selectable selcall digits"
parameter, the number of selectable digits can be set between 0 and 5. If 0
is assigned for the system group linked to the current channel, an error beep
will be emitted when executing this function, and the previously selected
entry mode will be retained.

The "Status ent." function allows editing of the status number. These digits
can be used in encode formats to define a status transmit message. Depending
on the system-group related "Selectable status digits" parameter, the number
of selectable digits can be set between 0 and 5. If 0 is assigned for the
system group linked to the current channel, an error beep will be emitted
when executing this function, and the previously selected entry mode will be
retained.

5.5.5 Encode instructions related to selcall

The selcall related encode definitions are:
- SEND, SLEN, SCHK, SDIAL
- TXS, TSET, TONE, LEN, DEL
- RIGN, RACK, RSMS, RSML
- EMGON, DIFIX, REP, CLACK
- TPE, TPD
- SELT, SELD, SELS, ENTTM
- OPEN, CLOSE, XOPEN, XCLOS
- SBUSY, WAITR, RSTDL, BEEP
- SELM, SELC, SELMC

The available selcall-related encode instructions offer a very flexible
solution to define transmit and receive selcall formats. Almost any existing
selcall format can be emulated with the encode/decode formats. In addition,
lockout-conditions and sub-audible tone generation can be controlled from
within encode formats.

Examples are included to explain some of the applications and the use of this category of encode and decode instructions.

The first category of encode instructions transmit one or multiple selcall digits. These instructions are: SEND, SLEN, SCHK and SDIAL.

The SEND instruction is used to transmit a single digit or multiple digits in a row with the same tone duration. Immediate as well as indexed digits can be transmitted. The available immediate digits range from 0 to 9, A, B, C, D and E. For example, to transmit digit 2 the following sequence is entered: 'SEND #2'. Also multiple digits can be sent, e.g. SEND #59402 to transmit fixed sequence 59402.

Indexed digits (also called 'indirect digits') are preceded with a pointer symbol and field designator. For example, to transmit the 1st and 3rd digit from the default transmit address SEND ^D13 should be entered. The following indirect pointer fields are available:

- ^D   Default transmit address
- ^P   Primary receive address
- ^S   Secondary receive address
- ^T   Third receive address
- ^Q   Temporary queue entry
- ^U   Status number
- ^M   Miscellaneous digits
- ^K   Keypad selectable digits

Some examples of encode sequences using the SEND instruction:

- SEND #12345:   Send fixed sequence 12345
- SEND #123^K45:   Send fixed 123 plus 2 last selectable digits
- SEND ^D123^K45: Send first three digits of Default Tx address plus two
                   keypad selectable digits
- SEND ^K12345:   Send full 5-digit selectable address

The SLEN 'ofs' instruction transmits the MOD 10 result of the free-dial string length added to the offset "ofs". The instruction is used within encode definitions to transfer free-dial number information to a telephone interconnect. It provides additional protection against false decoding. Three examples:

- Dialing string '1234567' (length 7), instruction SLEN 3
    (7+3) MOD 10 = 0
- Dialing string '456376247623' (length 12), instruction SLEN 9
    (12+9) MOD 10 = 1
- Dialing string '' (length 0), instruction SLEN 5
    (0+5) MOD 10 = 5

The SCHK instruction transmits the MOD 10 result of the sum of all preceding digits. The checksum result is reset to 0 at the start of the sequence. To reset the checksum within a sequence, a DEL or LEN instruction should be inserted. A few examples:

- Dialing string '1234567'   sum: 1+2+3+4+5+6+7=28, result: 8
- Dialing string '0528063355' sum: 37, result: 7

The SDIAL instruction transmits the free-dial string as individual selcall digits. The length of this free-dial string can vary from 0 to 28 digits. Together with the SLEN and SCHK instructions, SDIAL can be used to transmit a telephone number to a telephone interconnect according the Rohill standard. For this standard, the following encode definition is used:

SEND #59492 SLEN 7 SDIAL SCHK

Some examples of transmitted sequences using these encode instructions:

- Dial '0528063355' :   59492705280633553
- Dial '061234'   :   5949230612348
- Dial '' (no digits) :   5949276

The TXS instruction switches the transceiver to transmit mode with the selcall path enabled. All digit transmit functions will be translated to tones according to the selected selcall standard. The microphone will be muted during selcall transmission. Also, beeps will be muted to avoid interference to the transmit path. To avoid this (a key-Press or key-Hold beep suppressed) insert a DEL instruction before TXS so that the full beep is executed first.

The TSET instruction selects the toneset for transmission. The following eleven standard tonesets are available: ZVEI, CCIR, DZVEI, EEA, ZVEI-2, EIA, Natel, AP-369, PZVEI, PCCIR and PZVEI (section 5.5.3). For example, to select toneset ZVEI, type TSET ZVEI. If the TSET instruction is not used to select the toneset, the toneset selected under the "Selcall toneset standard" parameter in the System parameters window is used.

The TONE instruction is used to transmit a single-tone or a number of fixed tones in a sequence. Applications for this facility include transmission of all-calls and group calls, activation of a repeated, and transmitting calls to a fixed identity 2-tone pager (Motorola or GE standards, frequently used in the USA). The syntax of this instruction is TONE 'af-freq' where "af-freq" is any single-tone frequency between 300 and 3000 Hz. The duration of the tone is set by the instruction LEN, of which the description will follow. Note that during execution of TONE beeps will be muted.

The duration of selcall or DTMF digits and single-tones is set using the LEN instruction. This instruction must be placed before the transmit digi/tones instructions as SEND and TONE. The syntax is LEN 'xtime' where "xtime" is a number between 1 and 7000 specifying the duration per tone in 1 ms units.

The DEL instruction executes a delay. The duration of the delay can vary between 1 and 7000 ms. Applications for these instructions include lead-in and lead-out delays, and no-tone delays between multiple 5-tone sequences, e.g. 2*5-tone and 3*5-tone formats. The syntax is DEL 'xtime' where "xtime" is a number between 1 and 7000 specifying the duration of the delay in 1 ms steps.

The RIGN instruction can be used to ignore reception of selcall digits for a specified period of time. The most important application for this facility is to prevent the transceiver, where a call is initiated, from closing by Automatic-close after receiving the transpond message from the called transceiver. The syntax is RIGN 'stime' where "stime" is a period of time between 10 and 2550 ms in 10 ms steps.

The RACK instruction is used to check for a response from another transceiver after transmitting a call. Because a specific decode format can be linked, it is possible to check for a reply in any format. For example, the calling transceiver can check for a transpond message after transmitting a call, and show an acknowledge symbol when the call has been successfully sent. The syntax is RACK 'stime' 'dec' where "stime" is the period of time the decode sequence is valid, and "dec" is the linked decode format. After receiving a selcall sequence, the transceiver will always check first for an active decode format triggered by RACK, and if after executing this decode format without success, try the standard decode format.

Instruction RSMS (Resume Short) is used to restart the encode format after a specified period of time. The RSMS instruction is used together with the REP (repeat) instruction to create encode formats which are repeated for a number of times. Applications for these instructions include repeated emergency call transmissions and call retry until acknowledged. The syntax is RSMS 'stime' where "stime" is the period of time after which the current encode format is restarted, given the number of repeats has not been exceeded. Parameter "stime" can be set between 0 and 2550 ms in 10 ms steps.

Instruction RSML (Resume Long) has a similar function as RSMS. The syntax of this instruction is RSML 'ltime' where "ltime" is the period of time in seconds. This parameter can be configured between 0 and 255 seconds.

Using instruction EMGON (Emergency On), the display contents will be cleared, the LED will be switched off and audio will be muted. When used in an emergency call encode format, an emergency call or surrounding speech is transmitted after triggering the emergency call.

Using instruction DIFIX (Display Fix), the display contents will be frozen and audio will be muted. When used in an emergency call encode format, an emergency call or surrounding speech is transmitted after triggering the emergency call.

The emergency condition will remain active until the number of calls (using REP) has exceeded the maximum, or when a special call format is received which triggers decode function EMGOF.

The REP instruction is used to create an encode format of which execution is repeated until a certain condition exists. Applications are already mentioned in the description for instruction RSMS, which include emergency call transmission and repeating a call until an acknowledgment is received. The syntax of this instruction is REP 'repeatfactor' where "repeatfactor" is the number of repeats executed. Using RSMS and RSML, a period of time can be inserted before the current encode format is repeated. The repeated encode format is either stopped after exceeding the number of repeats, or after executing the decode instruction REPOF on a matching incoming call.

Instruction CLACK clears the ACK symbol (dot) on the display. CLACK can be used in conjunction with decode instruction ACK to provide a visible confirmation of a successful call, e.g. by checking for a 5-tone transpond message.

The TPE and TPD instructions are used to switch the transparency mode on and off. By switching on the transparency mode, a D-digit will be inserted after every four tones, to prevent a long string of tones from including valid selcall addresses. The transparency mode is switched on using TPE (Transparency Enable) and switched off using TPD (Transparency Disable). See also the description for application "free-dialing using selcall".

The SELT instruction requests the user to press "*" to confirm a single-tone transmission. When executed, 'TONE' will be displayed on the LCD. After pressing "*", this message will disappear and the encode format will continue.

The SELD instruction requests the user to enter and/or edit a free dialing string. It will initially show a blank display. When pressing digits, the digits will be added to the dialing number and will be shifted on the display from right to left. Key "#" will cause a B digit to be added, which is used to identify a wait-on-dialtone condition. Function "Clear digit" erases the rightmost digit. After pressing the "*" key, the dialed number will disappear and the encode format will continue. See also the table in section 5.7.1.

The SELS instruction is used for status digit entry. After execution of this instruction, the message 'St n' (portable) or 'STATUS n' (mobile) will show on the display, where n is the currently selected status digit. By pressing a numerical key the status number can be overwritten. Using key "C" the status digit can be reset to 0. By pressing the "*" key, the status message will disappear and execution of the encode format will resume. Note that this single digit status entry mode is different from the 5-tone status selection facility, which is triggered by the "Status ent." function.

Instruction ENTTM assigns the entry timeout. The syntax of this instruction is ENTTM 'ltime' where "ltime" selects the entry timeout, ranging from 0 to 255 seconds in 1 second steps. Note that value 0 defines an infinite timeout, thus the selected entry mode remains selected until a key-Press reloads the entry timer with the standard number entry timeout.

Instruction OPEN selects the selcall mute open state from within an encode format. This instruction can be used to force the user to listen to the radio channel before transmitting a call, while the transceiver is in the closed-mode. See also instruction XCLOS.

Instruction CLOSE selects the selcall mute close state from within an encode format. Its main purpose is to close the selcall mute function when a disconnect call is transmitted (sometimes used in selcall-based automatically controlled systems).

Instruction XOPEN exits the current active encode format and emits an error beep (if selected by ERRX1) when the selcall mute state is OPEN. Useful to ignore calls made while a connection exist (sometimes used in selcall-based automatically controlled systems).

Instruction XCLOS exits the current active encode format and emits an error beep (if selected by ERRX1) when the selcall mute state is in CLOSE. Can be used to prevent a user from listening first to activity on the channel before the call is made.

Instruction SBUSY skips the following SEND instructions when a carrier is detected at the time the encode format was started. This instruction can be used to skip transmission of lead-in digits when a carrier is detected at the time the call key is pressed, e.g. to activate a selcall-controlled repeater system.

Instruction WAITR delays execution of the next encode instruction until the currently pressed key is released. This encode instruction can be used to prolong transmission of DTMF tones in the DTMF overdial mode.

Instruction RSTDL repeats the currently executed encode format if more dialing digits are available in the overdial/direct dial digit buffer. This instruction can be used to retrieve still available digits from this buffer for DTMF overdialing, even if the PTT switch has already been released.

Instruction BEEP emits an alert tone from within an encode format. The syntax is BEEP 'num', where "num" is the beep number between 0 and 46. In general, beep numbers 8 to 31 are used for alerts. In appendix G an overview of the alert sequences can be found.

Instruction SELM puts the unit in Status message mode. In Status message mode, the user can select the status number to be sent by the SENDS instruction. Pressing the message key toggles between the status message and the status number. The status message, previously programmed via the FPU – Advanced Options/Status message, scrolls from right to left. Turning the channel knob scrolls through the list (01 to 32). Press the "*" key to assign the currently displayed status message or number to the SENDS instruction and continue with the encode format. Note that only the number (01 to 32) associated with the status message is sent. For example:

– SELM TXS DEL 100 TSET EEA LEN 40 SEND #49528 SENDS DEL 100 RX
This encode format sends both "49528" (SEND #49528) and the message number selected with the SELM instruction (SENDS).

Instruction SELC puts the unit in Queue message mode. In Queue message mode, the user can select the address to be sent by the SENDC instruction. Pressing the message key toggles between the address number and the address name. The address name, previously programmed via the FPU – Advanced Options/Queue message, scrolls from right to left. Turning the channel knob scrolls through the list. Press the "*" key to assign the currently displayed address number or name to the SENDC instruction and continue with the encode format. For example:

– SELC SELM TXS DEL 100 TSET EEA LEN 40 SENDC SEND #49528 SENDS DEL 100 RX
This encode format sends the user id selected by the SELC instruction (SENDC), "49528" (SEND #59528), and the message number selected by the SELM instruction (SENDS).

Instruction SELMC combines both SELM and SELC. By using this instruction the user can first select which message to send, then select who to send the message too.

5.5.6 Decode instructions related to selcall

Selcall related decode instructions include:
- CMP, STO, SSTO
- GRPN, GRPA, GRP0, GRP0A
- MONO, MONF, MONC
- BEEP, BEEPI, BEEPG
- ENCA, ENCI, ENCG
- DECA, DECI, DECG, DECF
- DECAT, DECIT, DECGT
- QUEUE, QUE1, QUE2, QUE3, QUE4, QUE5, QUE6, QUE7, QUE8
- DISPQ, DISPM, EMGOF, REPOF
- RSTUN, RVIVE, RKILL
- EXTAL, XPASS, ERASE, ACK

Decode formats are used to define sequences for receiving selective calls.
Incoming selective call messages can be compared to one or more formats, and
when a matching format is found, certain instructions can be executed, e.g.
to open the transceiver or to emit an alert beep.

The number of tones for an incoming call can be defined from 1 to 15. Fixed
digits as well as variable digits can be included in a format. The variable
digits can be stored in a queue entry if required.

Selcall formats consisting of two or more sequences separated by gaps can
also be defined and decoded. An example of such a format is the 2*5-tone
repeater access format, frequently used in France.

Decode instructions are also available for initiating a call when a matching
call has been received (transpond), or to link to other decode formats when
very complicated decode formats are required. Using this facility, an almost
unlimited number of decode addresses can be defined.

Furthermore, a selection of 47 alert sequences are available so that the user
can quickly determine the kind of call received (individual call, group call,
all call, secondary address call, remote close call, and so on). Finally, a
number of special decode instructions are available, e.g. for storing a queue
entry, remote stun, remote revive and remote kill.

Execution of decode formats is triggered by two conditions:
- When a no-tone condition occurs (time-out after the last tone within a
  selcall sequence has been received)
- When the selcall tone buffer of 16 digits is filled

For every system group a separate decode format is defined which points to
the decode format to be executed. It is also possible for a temporary decode
format to be activated by a RACK instruction (see section 5.5.5). Such a
temporary decode format is always executed first, and if no matching sequence
is decoded, the standard decode format will be executed.

The CMP instruction (for COMPARE) is the most frequently used decode
instruction. It compares one or more incoming selcall digits to a number of
fixed digits. This is continued until an 'executable' instruction is passed,
which then tests whether or not the incoming sequences match the fixed
sequence. If a match occurs, a decode flag is set.

The fixed digits can consist of immediate and/or indexed digits. Immediate
digits are fixed from within the decode format, so they cannot be different
for a single or a group of channels. An example of a compare immediate
sequence is 'CMP #59402' where incoming calls are compared to the fixed
sequence '59402'. Indexed digits are preceded with a pointer symbol and
field designator. These indexed digits are retrieved from one of the eight
5-tone addresses, of which four are defined per channel. For a list of
indexed digits, see the description of the SEND instruction in section 5.5.5.

The CMP instruction also accepts group digits. A group decode flag is set
when a group digit is received. This group decode flag is checked by some
executable decode instructions such as BEEP, BEEPI and BEEPG. It is possible
to select 0 and A as a group digit, which can be configured per sequence or
even per tone (see GRPN, GRPA etc. instructions).

The STO instruction (for STORE) can be used at positions where variable
digits are expected. The STO instruction can be preceded or followed by the
CMP instruction to create a decode sequence with fixed and variable digits.
The STO instruction accepts all digits from 0 to 9. If another digit is
received (e.g. B), then the STO command will mark the executed format as non-
matching.

The SSTO (status store) instruction is used for storing a 2 digit code in the
status buffer. The stored status can be shown on the transceiver display by
pressing the queue msg key while in queue mode.

Some examples of CMP/STO/SSTO sequences are:

- CMP #59402 STO 45 CMP #F
Matches to a sequence consisting of 7 tones, starting with '59402' and both
last digits between 0 and 9. The last two digits are stored at positions 4
and 5 of the temporary buffer.

- CMP #59 STO 4 CMP #0 STO 5
Matches to sequence '59v0v' where v is a variable digit with a value between
0 and 9. The first variable digit is stored in the 4th position of the
temporary buffer and the second variable digit is stored in the 5th position
of the temporary buffer.

- STO 12345 CMP #F
Matches to any 5-tone sequence consisting of digits between 0 and 9. All
digits are stored in the temporary buffer. Longer sequences are not accepted
(CMP #F).

- CMP #1 STO 2 CMP #345 STO 4531
Matches to sequence 'lv345vvvv' where the variable tones are stored in the
temporary buffer at positions 2, 4, 5, 3 and 1 from left to right.

- CMP #59402 STO 45 SSTO QUEUE DISPQ
When matched to sequence 59402 (CMP #59402), stores the next two digits
(digit places 6 and 7) in positions 4 and 5 of the temporary buffer (STO 45).
Then the following two digits (digit places 8 and 9) are stored in the Status
buffer (SSTO). The contents of the temporary buffer are transferred to the
queue (QUEUE) and shown on the display (DISPQ).

If the sequence matches, decode instruction QUEUE or QUEn can be used to copy

the contents of the temporary buffer to the queue table (see below). It is also possible to use the contents of the temporary buffer in encode formats, e.g. to create a transpond message.

Using the instructions GRPN, GRPA, GRP0 and GRP0A, the digits which are accepted as group digits can be selected. After execution of GRPN, no group digits are accepted. Using GRPA, A-tones are accepted as group digits, using GRP0, 0-tones are accepted as group digits and by executing GRP0A, both 0's and A's are accepted as group digits.

It is possible to mix CMP and GRP instructions to allow group digits on certain positions of the decoded sequence. Some examples are:

- GRPN CMP #594 GRPA CMP #02
Matches to incoming 5-tone sequence '59402', where the last two digits can be A-tone group digits.

- GRPA CMP #594 GRP0A #12
Matches to incoming 5-tone sequence '59412', where on all positions the A-tone is accepted as a group digit, and the 0-tone is accepted as a group digit in the last two positions.

Executing the MONO instruction will open the transceiver when the incoming sequence matches the defined sequence. Individual as well as group calls are accepted. When the MONO instruction is executed after a no-match condition occurs, nothing will happen.

The MONF instruction is similar to the MONO instruction, but the CALL indicator will also start to flash. This visual indication alerts the user that an incoming call has been received.

Instruction MONC performs exactly the opposite function as MONO, it will close the transceiver when a matching call is received.

The transceiver supports three instructions to emit an alert tone upon matching an incoming call; BEEP, BEEPI and BEEPG. Instruction BEEP emits an alert tone for both individual (no group tones found) and group (group tones found) calls. BEEPI is only executed when an individual call is received, and BEEPG will only operate when a matching group call is received. Using the BEEPI and BEEPG instructions, a distinctive alert can be generated so the user can quickly determine what kind of call is received. All three instructions have the syntax BEEPn 'num', where "num" is the beep number between 0 and 46. In general, beep numbers 8 to 31 are used for alerts. In appendix G, an overview of the alert sequences can be found.

Using the ENC series of instructions, a specific encode format can be executed on a matching incoming call. This instruction can be used to initiate a transpond message when receiving a call. Instruction ENCI is executed only when a matching individual call is received, ENCG is executed only when a matching group call is received and ENCA is executed for both individual and group calls. The syntax for these instructions is ENCn 'dec' where "dec" is the linked decode format. Later in this section, examples are given to explain these instructions.

The DEC series of instructions are used to link multiple decode formats for more complicated selcall sequences; normally required when the storage space of 64 bytes for a single decode format is not sufficient. When the matching condition is true, the decode sequence is immediately started, and the rest of the current decode format is not executed. The DECA instruction is executed when a matching group or individual call is received. DECI is executed only on individual calls, DECG is executed only on group calls, and DECF is executed only when no match has occurred. All instructions have the syntax DECn 'enc' where "enc" is the specified encode format. Examples are given later in this section.

Using the timed decode instructions DECAT, DECIT and DECGT, a second decode format can be activated during a selected period of time. These instructions can be used to check for multiple selcall sequences, like 2*5-tone and 3*5-tone. DECAT is executed on both group and individual calls, DECIT on individual calls only, and DECGT on group calls only. The syntax for these instructions is DECAT 'time' 'dec', where "time" is a time-out value of 0 to 2550 ms in 10 ms steps and "dec" is the decode format to activate. The syntax for DECIT and DECGT is the same. Examples are given later in this section.

Instruction QUEUE is used to copy the contents of the temporary buffer (see also STO instruction) to one of the available queue entries. This instruction is only executed when an incoming match (group or individual call) condition exists. The temporary buffer is copied to the top queue entry, and existing entries are shifted downwards. If the queue storage area is full, the earliest entry will be lost. Instruction QUEUE stores the 5-tone identity as well as the channel number where the call is received on, and allows duplicated storage. Operation of QUEUE is identical to operation of QUE1.

Instructions QUE1, QUE2, QUE3. QUE4, QUE5. QUE6, QUE7 and QUE8 operate similar to instruction QUEUE, but provide different methods of storage. By selection of the appropriate QUE instruction, it is possible to store the identity with or without the channel number, allow or not allow duplicate entries (two or more entries with the same channel number and identity), and use the FIFO (First In First Out) or FILO (First In Last Out) storage and retrieval method. In the table below, all combinations are shown.

Instruction	Storage Order	Duplicate	Store Channel
QUE1	FILO	YES	YES
QUE2	FILO	YES	NO
QUE3	FILO	NO	YES
QUE4	FILO	NO	NO
QUE5	FIFO	YES	YES
QUE6	FIFO	YES	NO
QUE7	FIFO	NO	YES
QUE8	FIFO	NO	NO

The DISPQ instruction will activate the queue mode, and thus will immediately display the first queue entry after executing this instruction. This instruction is executed only when a match condition exists. When preceded by the QUEUE or QUEn instruction, after receiving a call in a WHC (Who Has Called) format, the identity of the calling party will immediately be displayed in Numeric format.

The DISPM instruction activates queue mode, and displays the first queue entry. This instruction is executed only when a match condition exists. When preceded by the QUEUE or QUEn instruction, after receiving a call with a status attached, the calling party will immediately be displayed in Alphanumeric format.

The EMGOF instruction de-activates the emergency mode. EMGOF is executed only when a match condition exists, otherwise it is ignored. The emergency mode is activated by encode instruction EMGON, which is described in section 5.5.5. The EMGOF is normally used in a decode format, which is activated by an emergency encode format, and thus makes it possible for the dispatcher to remotely reset the emergency mode.

The REPOF instruction stops a repeating encode format. REPOF is normally used in a decode format directly linked to an encode format. Purposes of such an encode/decode format include a repeated emergency call and repeated call transmission until an acknowledge is received. The REPOF instruction is executed only when a match condition exists, otherwise it is ignored.

The remote control instructions RSTUN, RVIVE and RKILL can be used to temporarily or forever disable operation of a transceiver. The remote stun instruction RSTUN de-activates operation of a transceiver when triggered by a matching call. In the remote stun mode the display shows either 'LOC2' (portable) or 'LOCK 2' (mobile), operation of the transmitter is not possible, and the audio is muted. The transceiver is activated again after executing the RVIVE (remote revive) instruction. The RKILL (remote kill) destroys the contents of the EEPROM, so the transceiver has to be returned to the service shop for reprogramming. The remote kill feature is especially useful for secure applications, e.g. police forces, where operation of a lost or stolen transceiver is undesired.

Instruction EXTAL controls the external alert facility. On a matching sequence this instruction is executed only when the external alert facility has been activated by the user. The horn or lights, connected via a relay to the external alert output of the transceiver, can be driven with a specific rhythm, so that the user can easily distinguish a call alert from other events. This rhythm consists of eight slots of 500 ms duration each, specified as a series of eight 0s and 1s. For example, EXTAL 11011011 outputs three horn blasts of 1 second each with pauses of 0.5 second in between the blasts.

Instruction XPASS aborts execution of the decode format upon a matching sequence. This instruction is useful to ignore subsequently specified compare sequences when the previous sequence compares successfully, e.g. to avoid storage of a sequence into the temporary queue buffer.

Instruction ERASE erases the contents of the temporary buffer after the specified time. The syntax is ERASE 'time', where parameter "time" specifies the timer duration from 0 to 2550 ms in 10 ms increments. After this timeout has elapsed, the contents of the buffer will be replaced by F-digits.

Instruction ACK causes the transceiver to activate the acknowledge symbol (dot) on the display. This symbol can be used to inform the user that a call has been confirmed by the other party (e.g. by a 5-tone transpond message).

Some examples of decode formats:

- CMP #59402 MONO BEEP 12 ENCI Transpond
This format compares an incoming selcall sequence to 59402 (CMP #59402),
opens the transceiver when a matching call is received (MONO), emits alert
sequence 12 when a matching call is received (BEEP 12), and initiates
execution of encode format "Transpond" when no group digits are found in the
matching call address (ENCI Transpond).

- CMP #12345 MONF BEEPI 15 BEEPG 16 ENC Transpond
This format compares an incoming selcall sequence to 12345 (CMP #12345). If
a match occurs, the transceiver is opened with "MON" flashing (MONF), and
emits alert 15 if it is an individual call (BEEPI 15) or alert 16 if the
incoming sequence contains group digits (BEEPG 16). Encode format
"Transpond" is triggered for both individual and group calls (ENC Transpond).

- CMP ^P12345 #F MONF BEEP 8 CMP ^P12345 #CF MONC
If a 5-tone call is received with an identity matching the Primary Rx address
(^P pointer digits), then the transceiver will open (CMP ^P12345 #F), "MON"
will flash (MONF) and alert beep 8 will be emitted (BEEP 8). If the same 5-
tone identity plus C-tone is received, the transceiver will close (CMP
^P12345 #CF MONC). This remote close format is frequently used in
PYE/Philips systems.

- CMP ^P123 STO 45 CMP #F QUEUE MONO BEEP 12
This decode sequence checks if the first three digits received match the
first three digits of the Primary Rx address (CMP ^P123), if so it stores the
4th and 5th digits of the received selcall sequence in the temporary buffer
if they both are digits between 0 and 9 (STO 45), and checks for a no-tone
condition. If the incoming sequence matches the format, the temporary buffer
is copied to the queue (CMP #F QUEUE), the transceiver opens and alert 12 is
emitted (MONO BEEP 12).

- CMP #59420 RSTUN CMP #59421 RVIVE DECF DecSecond
This decode format compares the incoming sequence first to 59420 (CMP
#59420). If it matches, transceiver operation will be disabled (RSTUN). The
transceiver can be activated again by sequence 59421 (CMP #59421 RVIVE). If
the second compare fails, decode sequence "DecSecond" is executed (DECF
DecSecond), which can contain further decode instructions.

- CMP #592 DECA Decode592 CMP #5940 STO 5 QUE2 MONO BEEP 9
Any received selcall sequence starting with 592 will be decoded further in
decode format "Decode592" (CMP #592 DECA decode592). In the subsequent
compare instruction, the first four digits of the incoming selcall sequence
are compared to 5940 (CMP #5940), and the 5th tone will be stored in the
temporary buffer if between 0 and 9 (STO 5). If the call matches the
sequence, the digit will be stored in the queue (QUE2), the transceiver will
open and alert 9 emitted (MONO BEEP 9).

- [l] CMP #59403F DECAT 1500 DecNextFive
[2] STO 12345 CMP #F MONO QUEUE DISPQ BEEP 12 ENC Transp
The first decode format compares an incoming sequence to 59403, the
individual identity of the transceiver (CMP #59403F). If the call matches,
decode format "DecNextFive", shown as [2] will be active for 1.5 seconds
(DECAT 1500 DecNextFive). If another 5-tone call is received within these
1.5 seconds, all 5 digits will be stored in the temporary buffer (STO 12345).
If all digits are valid, the transceiver will open (MONO), the identity will
be stored in the queue (QUEUE), the queue entry will pop up on the display

(DISPQ), alert beep 12 emitted and encode format "Transp" executed (ENC Transp).

- CMP #59403F QUE1 DISPQ MONF BEEP 9 XPASS STO 12345 ERASE 800

This example shows a decode format for a 2*5-tone format with storage of the first 5-tone into the queue when the second 5-tone matches the individual address of the transceiver. If a 5-tone sequence is received which is different from sequence 59403, it will be stored in the temporary buffer and a timer is started for erasing this temporary buffer after 800 ms (STO 12345 ERASE 800). If within these 800 ms a 59403 sequence is received, the contents of this temporary buffer will be copied to the queue (CMP #59403F QUE1), and the queue contents will be shown on the display (DISPQ). The transceiver will open with "MON" flashing (MONF) and an alert beep will be generated (BEEP 9). The decode format is aborted by the XPASS instruction upon a successful match, so storage of the 59403 sequence in the temporary buffer is avoided.

5.6 QT/DQT transmit/receive

The mobile and portable transceivers should support both QT and DQT signaling. Because the applications for both QT and DQT are almost identical, QT and DQT is sometimes called SAT (for Sub Audible Tone) elsewhere in this section. Both systems employ the audio frequency band below 300 Hz.

5.6.1 Applications for sub-audible tone signaling

The QT and DQT sub-audible signaling standards are mainly used for the following purposes:

- Repeater access
- Closed user group communications

These applications and other capabilities of QT and DQT are explained below.

Repeater access

Both QT and DQT are transmitted continuously while transmitting speech. In a repeater application, the repeater will be activated when a carrier is received with a valid SAT. The repeater will then re-transmit the received signal further to increase the operating range of mobile and hand portable transceivers. Because of this, all transceivers must be programmed with a semi-duplex frequency.

A QT/DQT-driven repeater can use multiple decoders for QT and/or DQT to allow operation by multiple user groups. This is called a community repeater. Every subscriber has two or more transceivers with a fixed SAT code, which then can communicate through the repeater station. Using QT, 39 codes are available; DQT offers 83 codes.

Closed user groups

SAT signaling can also be used in transceivers on a simplex frequency without
a repeater site. In such an application, a single SAT encode/decode
frequency is programmed in all transceivers within a user group. During
transmission both the speech and the SAT are continuously sent. When the SAT
matches the programmed decode SAT in the receiving transceiver, the audio
will be unmuted and the user can hear the conversation. Other transceivers
listening to the same frequency, but with other SAT decode frequencies
programmed, will not unmute.

An obvious advantage of this application is the improved privacy allowed.

SAT lockout

SAT lockout can be used for both repeater access and closed user group
communications. By using specific encode instructions, it is possible to
prevent transmission of speech and/or calls when a SAT code is received that
is different from its own SAT decode.

By using SAT lockout in all transceivers operating in a repeater system, this
facility prevents a user who is outside the group currently using the
repeater site from being able to take over operation of the repeater. All
other parties have to wait until the repeater is free, before starting a
conversation. A repeater busy condition is normally visible on the display
of the transceiver.

Suppression of trailing noise

In two-way simplex operated radio communications, the receiving transceiver
will emit trailing noise after the PTT of the transmitting transceiver is
released. Tones with waveforms 180¡ reversed from QT are output, so the
receiving transceiver will mute before the carrier disappears. In DQT
systems, a special continuous tone is defined for this purpose, which is sent
shortly after releasing the PTT switch. The time between releasing the PTT
switch and sending the tone is defined by the DEL ÔxtimeÕ instruction in an
encode format.

Increased immunity to adjacent channel signaling

When multiple channels in a system are used with frequencies near each other,
the operation of transceivers can be disturbed by signaling and speech on
nearby busy channels. Signaling and speech on these nearby channels can
effectively be suppressed using sub-audible tone signaling, so the
transceiver will not be unmuted or called unnecessarily.

5.6.2 Parameters related to sub-audible tone signaling

Every channel can be independently configured for any of the available QT
frequencies or DQT codes, for decode as well as encode. It is possible as
well to select separate codes or frequencies for encode and decode, or to
select, for example, DQT for encode and QT for decode.

On a per channel basis, parameter "QT/DQT encode" selects the required QT
frequency or DQT code for transmitting. Using specific encode instructions,
which are explained in section 5.6.4, QT and DQT can be activated and de-

activated from within an encode format. For QT, the exact frequency in Hz
should be entered, or one of the available call signs. These can be found in
appendix D.

For DQT, one of the available three digit octal codes is entered, which can
be found in appendix E. When this field is cleared or when "Off" is entered
in this field, DQT and QT signaling are both switched off. It is possible
also to enter an "I" plus a valid three-digit DQT code to obtain inverted DQT
codes.

Parameter "QT/DQT decode" selects the required QT frequency or DQT code for
receiving. For QT, the exact frequency in Hz should be entered, or one of
the available call signs. These can be found in appendix D. For DQT, one of
the available three digit octal codes is entered, which can be found in
appendix E. When this field is cleared or when "Off" is entered in this
field, DQT and QT decoding are both switched off. It is possible also to
enter an "I" plus a valid three-digit DQT code to check for inverted DQT
codes.

The "Monitor function" parameter defines the use of the "Monitor" function
(5.5.4) for each system group separately. The operation of this parameter is
described in detail in section 5.5.3.

5.6.3 Key definitions related to sub-audible tone signaling

In the programming software it is possible to configure a key on the mobile
for "QT/DQT monitor". By pressing this key, it is possible to bypass the
sub-audible tone squelch and thus listen to activity on the radio channel.
By pressing this key again, the audio is muted.

The "Monitor" function operates both selcall and QT/DQT mute. Its operation
is described in detail in section 5.5.4.

5.6.4 Encode instructions related to sub-audible tone signaling

A number of encode instructions are related to SAT signaling. These
instructions can be used in encode formats linked to call keys PTT-press and
PTT-release. A few examples are included at the end of this section to
explain the applications of these instructions. A description of the
following encode instructions is included in this section:

- SCTP, SCT
- SCRP, SCR
- SCOFF, SCPH, DTAIL
- XCTCN, XCTCW
- XSAT

Instruction SCTP activates SAT transmission (either QT or DQT) from within an
encode format. The programmed SAT frequency or code will be used. Normally
this instruction is used at the position after TXS or TXM (transmitter on).
By omitting this instruction for certain encode formats, it is possible to
transmit, for example, selcall messages without a sub-audible tone.

Instruction SCT activates SAT transmission from within an encode format using the QT frequency or DQT code specified. This allows transmission of a SAT frequency or code different from the fixed SAT for the selected channel. The syntax of this instruction is SCT 'st-tone', where "st-tone" is a QT frequency in Hz, a normal DQT code (D plus three digits plus N), or an inverted DQT code (D plus three digits plus I).

Instruction SCRP selects the SAT frequency or code for receiving as configured for the current channel. This instruction is useful only for applications where the encode format causes the transceiver to temporarily switch back to receive.

Instruction SCR is similar to SCRP, but for SCR a specific SAT frequency or code can be specified. The syntax of this instruction is SCR 'st-tone', where "st-tone" is a QT frequency in Hz, a normal DQT code (D plus three digits plus N), or an inverted DQT code (D plus three digits plus I).

Instruction SCOFF can be used to switch off SAT encode from within a sequence. This instruction can be used to mute the transceiver of the receiving party while the transmitter continues to operate, and thus suppress the trailing noise.

Instruction SCPH causes the QT sine wave to skip 180 degrees of phase. This will mute the receiving equipment of the other party quicker than only switching off QT.

Instruction DTAIL triggers transmission of the standard DQT tail tone of 135 Hz. This tail tone is transmitted after speech transmission for rapid switch-off of the DQT decoder within the listening transceiver.

When instruction XCTCN is executed from within an encode format, this encode format will be quit when a carrier is received without SAT or carrier with the wrong SAT. This instruction can be used to define a SAT lockout.

Instruction XCTCW works similarly, but also quits the encode format when no carrier is received. This means that execution is only continued when the correct SAT is received.

Instruction XSAT quits execution of the current Encode format when the QT/DQT specified with 'st-tone' is received.

Examples of encode formats:

- TXM SCTP
Encode format for PTT-press. Selects transmit microphone mode and switches on the sub-audible tone.

- ERRX1 XCTCN TXM SCT 100.0
Exits the current encode format when a carrier is received without SAT or with a wrong SAT. If the channel is free or the correct SAT is received, the transmitter is activated, and a QT frequency of l00 Hz is transmitted, irrespective of the selected encode SAT for the current channel.

- TXS SCPH DEL 150 DTAIL DEL 200 RX

Linked to PTT-release to prevent trailing noise from being heard at the receiving transceiver. First, the transmitter audio is muted. Next, according to the type of transmitted SAT tone, either a 180 degree shifted QT sine wave will transmit for 150 ms (SCPH DEL 150) or a 135 Hz tail tone will transmit for 200 ms (DTAIL DEL 200). Finally, the transceiver will switch to receive mode.

5.6.5 Decode instructions related to sub-audible tone signaling

The transceiver supports one decode instruction related to sub-audible tone signaling:

- CKSAT

Instruction CKSAT checks whether a valid DQT code or QT tone is currently being received on the radio channel. If not, or a wrong QT tone or DQT code is being received, the match flag will be reset. If no DQT or QT is programmed for the selected radio channel, the match flag will not be affected.

5.7 DTMF encode

The DTMF encode facility allows transmission of DTMF (Dual Tone Multiple Frequency) tones from the transceiver. Transmission of DTMF tones is fully controlled from within encode formats.

5.7.1 Operation of DTMF encode

The digits can be transmitted one-by-one from the keypad, or a number of digits can be entered and edited in a buffer before the number is sent as separate digits.

The most frequently used operation of DTMF encode is the overdialing method. By pressing the Push-To-Talk switch, and then pressing a key on the keypad while keeping the PTT switch pressed, a DTMF tone can be sent. By using encode formats, the duration of the tone can be fixed and also a pause can be inserted between the digits. The transceiver software buffers enter digits in the overdialing mode when another key is pressed before the previous DTMF tone is fully transmitted.

In the table below, the different dialing methods and their display presentations are shown.

| Key | Overdial/On-hook | | Free-dial/Off-hook | | Direct DTMF | |
	Display	Send	Display	Send	Display	Send
0	0	0	0	0	0	0
1	1	1	1	1	1	1
2	2	2	2	2	2	2
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	5	5	5	5
6	6	6	6	6	6	6
7	7	7	7	7	7	7
8	8	8	8	8	8	8
9	9	9	9	9	9	9
A	A	A			A	A
B	B	B			B	B
C	C	C	not used		C	C
D	D	D			D	D
*	*	*	(continue enc.format)		*	*
#	#	#	B	B	#	#

5.7.2 DTMF related parameters and instructions

Because all DTMF functions are executed from within encode formats, there is only two DTMF specific parameters defined.

Parameter "Encode DTMF overdial" in each system group is used to link an encode format to the overdialing function. The linked encode format will be triggered each time a key on the optional DTMF keypad (0 to 9 *, # and A to D) is pressed while the Push-To-Talk switch is held down. See also example DTMF over-dialing encode format.

Parameter "Encode DTMF direct" in each system group allows the definition of an encode format to be executed each time a numerical key, *, # or ABCD key is pressed while in the DTMF entry mode. Simultaneously pressing the PTT switch is thus not necessary.

The following encode format instructions are related to DTMF encode functions:

- TXD
- SELD

Instruction TXD connects the transmit audio path to the DTMF chip. In this mode, all digits sent for selcall are now sent as DTMF digits. In this mode, the microphone will be muted. In section 5.5.5, the send instructions for selcall encode are explained (SEND, SLEN, SCHK and SDIAL). Also, beeps will be muted to avoid interference to the transmit path. To avoid this (key-Press or key-Hold beep suppressed) insert a DEL instruction before TXD so that the full beep is executed first.

For overdialing, a special digit within the miscellaneous 5-tone address is reserved. The 2nd digit, pointed to by ^M2, is used for this facility. The value of this digit will be updated each time a new key is pressed on the

keypad in the overdialing mode. Note that entered digits are buffered to prevent this digit from being overwritten too soon.

The SELD instruction executes the free-dial entry mode for numbers up to 28 digits. Operation of this mode is also explained in detail in section 5.5.5.

Examples of encode formats for DTMF transmission:

- TXD DEL 100 LEN 200 SEND ^M2 DEL 100 TXM
This encode format for DTMF overdialing first selects the DTMF transmit mode (TXD), executes a delay of 100 ms (DEL 100), and then transmits the selected DTMF tone for 200 ms (LEN 200 SEND ^M2). A delay of 100 ms follows (DEL 100), after which the microphone is enabled again (TXM).

- SELD TXD DEL 200 LEN 80 DEL 50 SDIAL DEL 50 RX
This encode format can be used for DTMF dialing. First the free-dial entry mode is selected (SELD). After entry and confirmation, the transmitter is activated with the DTMF audio path enabled (TXD). A lead-in delay of 200 ms is executed (DEL 200), after which the duration per tone is set to 80 ms (LEN 80). The interdigit pause is selected (DEL 50). Note that this delay value is used as a reference for the interdigit pause. All digits are transmitted in a row (SDIAL). After transmission of the digits, a lead-out delay of 50 ms is executed (DEL 50), and the transceiver is switched to the receive mode (RX).

5.8 Miscellaneous

In this section, a number of miscellaneous transceiver functions are described.

5.8.1 Return-to-standby

Using the Return-to-standby facility, the behavior of the transceiver can be configured such that the user cannot or is discouraged from using the transceiver without 'permission' of the dispatcher. Listening only to a radio channel becomes quite difficult as well. The Return-to-standby facility is supported by multiple parameters and encode/decode instructions to optimize this facility for a given application.

The following parameters and format instructions are used to configure the Return-to-standby facility:

Optional features/
- Rts listen period
- Rts active period

sYstem parameters/
- Return-to-standby mode

Encode format instructions:
- RTSL
- RTSA
- RTSO
- XIDLE
- XLIST

Decode format instruction:
- CLOSE

The "Rts listen period", Return-to-standby listen period, parameter specifies
the period of time the user of the transceiver is able to monitor channels
before transmitting a call. Such a monitoring facility is required in some
countries for transmitting selective calls on conventional channels. The
Return-to-standby listen mode can be activated by pressing the key for
open/close. After the Rts listen period expires, the transceiver will
automatically close again. Using certain encode format instructions,
operation of the PTT switch and call keys can be customized. Normally, the
PTT is ignored in the Rts listen period to prevent the user from starting a
conversation in this mode. The Rts listen period will not be reset by a
carrier or while transmitting unlike the Rts active period. The "Rts listen
period" can be set between 0 and 255 seconds in 1 second steps.

The "Rts active period" parameter specifies the period of time after which
the transceiver is closed when either the PTT is not pressed or the channel
is not occupied. This timer is reloaded while the PTT is pressed, and while
the channel is occupied. If a SAT decode tone or code is assigned for the
selected channel, the channel is regarded as occupied while the correct SAT
is received, otherwise this function will be noise squelch driven. The value
of this parameter can be set between 0 and 255 seconds in 1 second steps.

The "Return-to-standby mode" parameter selects whether or not the Rts
facility is used by the channels belonging to the system group. If set to
"Disable", Rts does not operate. If set to "Tx-only", the Rts timer is
retriggered while transmitting in the active mode. If set to "Rx/Tx", the
Rts timer is retriggered while transmitting as well as receiving (carrier
detect or SAT operated).

Encode instruction RTSL reloads the Return-to-standby timer to the period of
time as specified by the "Rts listen period" parameter if the Rts mode is
currently not active; otherwise, it will reload the Return-to-standby timer
to the period of time as specified by the "Rts active period" parameter if
the Rts mode is currently active.

Encode instruction RTSA reloads the Return-to-standby timer to the period of
time as specified by the "Rts active period" parameter, and will also select
the Rts active mode.

Encode instruction RTSO reloads the Return-to-standby timer to the period of
time as specified by the "Rts active period" parameter, only when already in
the active mode. In the idle or listen (monitor) state, the Rts timer will
not be set.

Encode instruction XIDLE will quit the currently executed encode sequence
when the Rts mode is set to "idle". This instruction will be ignored when
the Rts mode is set to "listen" (monitor) or "active" or when the Rts mode is
disabled for the system group in use.

Encode instruction XLIST will quit the currently executed encode sequence
when the Rts mode is set to "idle" or "listen" (monitor). The instruction
will be ignored when the Rts mode is set to "active" or when the Rts mode is
disabled for the system group in use.

Decode instruction CLOSE sets the match flag if the currently executed decode
format has been triggered by the Rts listen or active timer. If not, the
match flag will be reset. Following this CLOSE instruction, a MONC and/or
BEEP can be used to provide an automatic close on timeout with alert beep, or
a transmission of a close-call can be triggered.

5.8.2 PTT timeout

The PTT timeout facility limits the period of time a user is able to
continuously transmit. This prevents damage (overheating) of the RF power
amplifier and blocking of a radio channel for a long time when the Push-To-
Talk switch is pressed continuously. The parameter "time out timer (TOT)" is
selectable in 30 second steps between 30 and 300 seconds, and its operation
is valid for every channel. It is possible to disable operation of the PTT
timeout facility by selecting "Off" for this parameter.

Parameter "TOT pre-alert" (Edit/Optional features) allows selection of a
period of time the transceiver emits an alert beep before the PTT timer times
out. For example, if this parameter is set to 50 seconds, and the PTT
timeout is set to 60 seconds, the transceiver will emit an alert at the 50th
second while pressing the PTT switch. This parameter is also selectable in
10 second steps between 10 and 250 seconds. Value "Off" disables this
parameter. This parameter is valid for every channel programmed.

Parameter "TOT rekey time" selects a period of time the user is not able to
transmit after the PTT timeout has expired. It prevents users from occupying
a radio channel by releasing and pressing again the PTT switch as soon the
PTT timeout switches off the transmitter. This facility is sometimes
required for operation of the transceiver in community repeater systems. The
value of this parameter is selectable between 1 and 60 seconds in 1 second
steps. Value "Off" disables this parameter. Also, this parameter is valid
for every programmed channels.

5.8.3 Battery save mode

Portable only:
The "Battery save" parameter increases the battery operation time by
switching off the receiver for small periods of time when the carrier is
absence. By choosing a suitable duty-cycle for receiver activity, it is
possible to both save battery power and have an acceptable response time upon
a carrier-detect condition. The choices available are Off, Short, Medium, and
Long. The duty cycles (receiver ON/OFF times) are as listed below.

	Receiver OFF	Receiver ON
Short	200 ms	100 ms
Medium	400 ms	100 ms
Long	800 ms	100 ms

Note that the Battery save parameter waits 5 seconds after the start of a no
carrier condition before executing.

For some applications the "Battery save" facility is not suitable, for
example, when expecting fast selective call messages. However, if the
duration of the first digit is long, it is possible to use this facility.

5.8.4 Text output to display

The text output facility is useful for e.g. displaying the serial number of
the transceiver upon power up. Text output can be initiated from an encode
format using two encode instructions.

Encode instruction TEXT 'text' outputs text string "text" to the display.
Any ASCII character can be included in the text string. The text scrolls
from the right to left on the display. If more than 4 characters (portable)
or 9 characters (mobile) must be displayed, it is possible to scroll the text
with slower speed. The shifting speed can be set using the LEN instruction.
Instruction TXTOF switches the display back to the normal operation mode.
Example of an encode format which outputs the text 'HELLO' follows:

LEN 100 TEXT ' HELLO' DEL 500 TXTOF

6. PROGRAMMING

6.1 Channel

The Channel (parameters) window enables the selection of channel-related parameters. In this window only the most frequently-used parameters can be edited. An additional window can be opened to select other channel-related parameters. See section 5.5 for instructions on how to switch between these windows.

Receive frequency
Range: depending on selected model
Step size: 5.00 / 6.25 kHz
The receive frequency in MHz for the selected channel is entered here. This parameter can be edited in the Channel window as well as in the Channel Information window. Entered frequencies are only accepted if valid for the selected transceiver model, and are rounded off to the nearest available frequency.

Transmit frequency
Range: depending on selected model
Step size: 5.00 / 6.25 kHz
The transmit frequency in MHz for the selected channel is entered here. This parameter can be edited in the Channel window as well as in the Channel Information window. Entered frequencies are only accepted if they are valid for the selected transceiver model, and are rounded off to the nearest available frequency.

QT/DQT Decode
Range: 67.0-250.3 Hz, QT callsigns, valid DQT codes. inverted DQT codes
Determines the QT tone or DQT code that is used to detect if the right subtone is received on the selected channel. This parameter can be edited in the Channel window as well as in the Channel Information window. Refer to appendix D for an overview of valid QT tone frequencies and appendix E for an overview of valid DQT codes.

QT/DQT Encode
Range: 67.0-250.3 Hz, QT callsigns, valid DQT codes, inverted DQT codes
Determines the QT tone or DQT code that is used when the transceiver is transmitting on the selected channel. This parameter can be edited in the Channel window as well as in the Channel Information window. Refer to appendix D for an overview of valid QT tone frequencies and appendix E for an overview of valid DQT codes.

Channel Name
Range: 0..9, A..Z, -, +, /, =, *, <comma>,), (, @, $, %, \, _, <space> and # for overlay text
Determines how the channel number will be displayed to the user. It consists of three digits with a limited number of characters if the numerical format is chosen, or consists of four characters if the alphanumeric format is selected (see section 4.8).

Power select
Portable Range: Low, Med, Hi
Mobile Range: Low, High
Sets the transmit power.

Frequency shift
Range: No, Yes
Moves the crystal clock frequency slightly; may be useful to prevent
interference on some radio channels. If you notice interference on a
specific channel during operation, try setting this parameter to "Yes" for
that channel.

Local/Distance (mobile only)
Range: Local, Distance
Local allows the receive attenuator to be activated, and Distance does not
allow the receive attenuator to be activated. Make this selection based on
whether priority is given to sensitivity or mutual modulation
characteristics.

Wide/Narrow (mobile only)
Range: Wide, Narrow
Selects either Wide or Narrow. However, note that this parameter can be
selected only when Wide&Narrow under Personality is set to Wide 5k/Narrow or
Wide 4k/Narrow.

Auxiliary (mobile only)
Range: No, Yes
Sets whether to use auxiliary.

Scan include list (multi-channel models only)
Range: set of 0 .. 9
Defines the scan groups to which the channel belongs. If a digit is shown,
the channel is included in that particular scan group. If the channel does
not belong to a defined scan group, a dash symbol will be shown at that
position. Unused scan groups are shown as squares. Editing this parameter
is possible by entering the scan group numbers in one string. For example,
enter 156 to include the current channel in scan groups 1, 5 and 6.

System reference
Range: <available system groups>
Links the currently selected channel to one of the defined system groups.
Refer to section 6.6 for details on System group parameters.

Default Tx address
Range: 00000 .. 99999
Step size: 1 (0..9, A..F)
Defines the selectable part of the transmit selcall address. This address is
used at transceiver turn-on, when the channel is selected while the parameter
"Copy from default tx" in the Optional features window is set to Enable, or
when the contents of the keypad buffer are replaced upon entry of another
selcall address. This parameter is normally used to define the most
frequently called 5-tone identity, but it can also be used for other
purposes.

Primary Rx address
Range: 00000 .. 99999
Step size: 1 (0..9, A..F)
Defines the primary identity of the transceiver. In most applications, this
parameter is used to define the 5-tone address of the unit being used.

Secondary Rx address
Range: 00000 .. 99999
Step size: 1 (0..9, A..F)
Defines the secondary identity of the transceiver. In most applications,
this parameter is used to define the second 5-tone address of the unit being
used.

Third Rx address
Range: 00000 .. 99999
Step size: 1 (0..9, A..F)
Defines a third identity of the transceiver. In most applications, this
parameter is used to define the third 5-tone address of the unit being used.

Voice Scrambler (optional)
Mobile Range: 1 to 16, Off
Portable Range: 1 to 4, Off
Sets the scrambler code. Visible only when Voice Scrambler type is set to B.
Set to "Off" when not using the scrambler option.

6.2 Model

Mobile:
The Personality window enables the selection of the transceiver model to be
configured. After starting up KPG-28D, the parameters in the window must be
edited first.

Below follows a description of the parameters of the Personality window. If
no ranges are given, you have to select the relevant value by means of the
space-bar or the cursor command keys.

Model name
Displays the selected model name.

Wide & Narrow
Range: Wide 5k/Narrow, Wide 4k/Narrow, Wide 5k/Wide 4k, Narrow
Selects whether it is possible to switch between fixed to Wide or Narrow, or
Wide & Narrow. However, note that even if this is set, switching is not
possible for items for which the transceiver does not correspond or for items
which are not remodeled. When this setting has been switched, adjust the
Deviation and Balance.

Option unit
Range: No, Yes
Sets whether it is possible to attach optional units such as the mobile data
terminal.

Scrambler unit (optional)
Range: No, SC-A, SC-B
Sets whether it is possible to attach the optional scrambler unit (not sold
by KENWOOD). SC-A represents MASC (Marconi) and SC-B represents SC-460
(transcript).

Portable:
The Model menu lets you select the type of transceiver you are programming
(TK-259, TK-359), its frequency range, and whether the Voice Scrambler unit
is installed or not. You should set the parameters in the this menu upon
start-up of the KPG-32D software. Below is a description of the parameters.

VHF window
Range: F1.150-174 MHz, F2.136-150 MHz
Displays the available frequency ranges for the TK-259 transceiver.

UHF window
Range: F1.450-470 MHz, F2.406-430 MHz
Displays the available frequency ranges for the TK-359 transceiver.

Voice Scrambler Unit
Range: Yes, No
Tells the program whether an optional scrambler unit is installed or not.

Voice Scrambler Unit type
Range: A, B
Tells the program which type of Voice Scrambler Unit (not sold by KENWOOD) is
installed; A for the MASC (Marconi) type, B for the SC-460 (transcript) type

6.3 Key assignment
     Mobile : Panel key assignment   Mic key assignment
     Portable: Top/side key assignment   Front key assignment

The keys on both the optional DTMF keypad (0..9, A..D, * and #), and on the
transceiver can be assigned key functions to each of the following actions:
Press, Hold, Shift, and Release.

Press: Function executed immediately after pressing key
Hold: Function executed after holding down key for programmed time.
Shift: Function executed when key is pressed while in Shift mode
Release: Function executed after releasing key within programmed time.

The functions listed in section 4.7 are available for each of the key actions
above.

6.4 Scan information

Multi-channel models only:
A separate scan group can be defined for each scan application. Each scan group can contain a number of channels, ranging from 2 to all channels defined. The parameter "Scan include list" in the Channel window is used to link channels to scan groups. The following parameters are available for each scan group:

Priority channel
Range: None, 1 .. 250
Step size: 1
Determines which channel functions as the Priority channel. The entered channel number must be from the 'Ch No.' column of the Channel Information window.

Preference channel (pref)
Range: None, 1 .. 250
Step size: 1
Determines which channel functions as the Preference channel. The Preference channel can be used for various purposes related to scan operation, but it is mainly used to force the transceiver to transmit on this channel when the PTT switch is pressed while the transceiver is in scanning mode.

Look back time A
Range: 0.3 .. 5.0 s
Step size: 0.1 s
Determines the period of time during which signals are received using a channel other than the Priority channel when the Priority channel is not busy and while scan is halted.

Look back time B
Range: 0.5 .. 5.0 s
Step size: 0.5 s
Determines the period of time during which signals are received using a channel other than the Priority channel when incorrect signals are present on the Priority channel and while scan is halted.

User program
Range: Disable, Enable
Determines whether the user is allowed to program the scan list and the Priority channel for the current scan group (Enable) or not (Disable).

6.5 Optional features

Optional features enables the selection of transceiver options, such as the startup conditions and user interface (except key definitions). The Optional features are valid for all programmed channels.

Time Out Timer (TOT)
Range: Off, 30 .. 300 s
Step size: 30 s
Determines the maximum duration of continued transmitting while the PTT switch is pressed. After this transmit time-out period has expired, the transceiver will emit an error beep, and stop transmitting. Suggested value: 60 seconds. Enter "Off" to disable the transmit time-out facility.

TOT pre-alert
Range: Off, 10 .. 250 s
Step size: 10 s
A separate timer used to emit a warning beep before the transmit TOT period expires. For example, if the TOT is set to 60 seconds and the TOT pre-alert is set to 50 seconds, a warning beep will sound 10 seconds before the TOT expires. If you enter a value that is higher than the transmit time-out value, no transmit warning will be generated. Suggested value: 10 seconds before the TOT time.

TOT rekey time
Range: Off, 1 .. 60 s
Step size: 1 s
Defines the period of time between which the transmit time-out timer has fully expired and the time you can start transmitting again. This function is sometimes required by operators of repeater systems. Suggested value: 10 seconds.

TOT reset time
Range: Off, 1 .. 15 s
Step size: 1 s
Determines the period of time for the timeout timer (TOT) to reset after the PTT switch is released.

Control tone
Range: No, Yes
Set to sound a tone when turning the power on or during operations.

Warning tone
Range: No, Yes
Set to sound the tone during warnings.

Off hook decode (mobile only)
Range: No, Yes
The radio is still tone squelched even though the microphone is in an off-hook state (valid for QT and DQT decode). In this state, selecting Yes enables decode signaling; selecting No disables decode signaling, and enables carrier squelch.

On hook PTT (mobile only)
Range: No, Yes
Sets whether to transmit in an on-hook state.

Off hook scan (mobile only)
Range: No, Yes
Sets whether the mobile is able to scan even though the microphone is off-
hook. For 2-channel models, this selection is not available.

Ext.alert/transfer (mobile only)
Range: None, Ext.alert, Transfer, Ext/Trans
Selects whether none, either external alert or transfer, or both external
alert and transfer can be activated by the user.

Normal display format (multi-channel models only)
Range: Both, Selcall, Channel
Determines the way in which the selcall information and channel numbers are
displayed (see section 4.8).

Battery Save (portable only)
Range: Off, Short, Medium, Long
Determines the period of time the radio stays in standby mode before
switching back to ready mode to check for activity.

DTMF enc. side tone (portable only)
Range: Off, On
Set for a side tone to be output from the speaker when DTMF tones are
encoded.

Channel readout (portable only)
Range: Numeric, Alphanum
This parameter determines the type of channel readout. If "Numeric" is
selected, a maximum of three digits are shown on the display with or without
"ch" in the bottom left-hand corner, depending on which Normal display format
is chosen (see above). "Alphanum" mode can show up to four characters in the
middle of the display. Note that alphanumeric characters and channel numbers
longer than 99 are not clearly shown when the Normal display format (see
above) is set to both (see section 4.8).

Invert display (portable only)
Range: Disable, Enable
Reverses the LCD display.

Lock code
Range: 0000 .. 9999
Step size: 1
Determines the code with which the user can lock and unlock the transceiver
unit. In the locked state, all normal transceiver functions are disabled,
thus preventing unauthorized use of the transceiver.

Keypad operation
Range: DTMF, Selcall, Channel, Status
Determines the primary use of the numeric keypad field. If this parameter is
set to Channel, the transceiver switches to the channel entry mode as soon as
a digit is pressed. If set to Selcall, the selcall entry mode is activated
instead. If set to Status, the status entry mode will be activated. If
keypad operation is set to DTMF, the direct DTMF entry mode will be selected
(this will cause the transceiver to transmit a DTMF digit immediately).

Number entry timeout
Range: 0 .. 255 s
Step size: 1 s
Determines the period of time the transceiver stays in the selected entry
mode (for example, entry of selcall address or free-dialing telephone
number), before switching back to the default operating mode. Suggested
value: 30 seconds.

Overlay text channel (mobile only)
Range: 8-character string
Defines the overlay text for the numerical channel readout mode. The eight
character string will be displayed in a 13-segment form, which approaches the
layout of the characters used as much as possible. For 2-channel models,
this selection is not available.

Overlay text selcall (mobile only)
Range: 8-character string
Defines the overlay text for selcall address selection. The eight character
string will be displayed in a 13-segment form, which approaches the layout of
the characters used as much as possible. For 2-channel models, this
selection is not available.

Overlay text status (mobile only)
Range: 8-character string
Defines the overlay text for status number selection. The eight character
string will be displayed in a 13-segment form, which approaches the layout of
the characters used as much as possible. For 2-channel models, this
selection is not available.

Mode / Main
Range: Disable, Enable
Sets whether main programming is possible.

Mode / Panel test (portable only)
Range: Disable, Enable
Sets whether various test are performed by the dealer.

Mode / Panel tuning (portable only)
Range: Disable, Enable
Sets whether panel tuning is possible. Only basic adjustments can be made
via Panel tuning.

Start up / Scan (multi-channel models only)
Range: Back up, 1 .. 9, 0
Determines which scan group is scanned upon transceiver power on
(groups 0 .. 9). If set to "Back up" the transceiver will remember the last
condition of Scan and upon Start up continue at that point. If scan was not
active at power off, "Back up" will not start scanning upon power on.

Start up / Monitor
Range: Disable, Enable
If Monitor is set to "Enable", selcall mute will be open upon transceiver
switch-on. If set to "Disable", selcall mute will be initially closed.

Start up / Encode def.
Range: [Disable], <defined encode formats>
Enables the selection of a transmit encode definition to be executed
immediately after the transceiver is switched on. This facility can be used,
for example, to register a transceiver within a system. Selection of a
startup encode definition is only possible if the definition has already been
entered with the encode format editor.

Start up / Channel
Range: Disable, 1 .. 250 (2-channel model: Disable, 1 .. 2)
Step size: 1
This parameter determines which channel is selected upon transceiver switch-
on. The channel number refers to the number in the "Ch No." column of the
Channel Information window, not the channel name. This parameter determines
whether the last channel number selected before the transceiver is switched
off is automatically selected again upon transceiver switch-on.

Alert volume level (portable only)
Range: 1 .. 256
Step size: 1
This parameter sets the level for selections Low and High of the "alert
volume" function.

OPT MDT / Data PTT with QT/DQT (mobile only)
Range: Off, On
Sets whether to transmit QT/DQT when inputting from the mobile data terminal.
However, note that this item can be selected only when Option unit under
Personality is set to Yes.

OPT MDT / Data PTT with mic mute (mobile only)
Range: Off, On
Sets whether to mute the mic when inputting from the mobile data terminal.
However, note that this item can be selected only when Option unit under
Personality is set to Yes.

OPT MDT / TX sense (mobile only)
Range: Mic PTT, PTT input, TX line
Sets the output signal at PTT out when inputting from the mobile data
terminal. However, note that this item can be selected only when Option unit
under Personality is set to Yes.

Rts listen period
Range: Off, 1 .. 255 s
Step size: 1 s
Determines the period of time the user can monitor a channel to initiate a call, before the transceiver automatically closes again. This facility is used together with selcall encode/decode facilities to prevent unnecessary operation of the equipment. An additional PTT lockout condition is available when the transceiver is in the listening mode. Suggested value: 10 seconds.

Rts active period
Range: Off, 1 .. 255 s
Step size: 1 s
Determines the period of time in the active state (conversation mode) after which the transceiver is closed automatically if PTT is not pressed and no carrier is received. Suggested value: 30 seconds.

Hold delay
Range: Off, 10 .. 2550 ms
Step size: 10 ms
By using this parameter you can effectively increase the Hold action time from 500 ms up to 2.55 seconds. For example, to increase the amount of time the emergency key must be pressed before an emergency procedure is activated do the following: 1. set the Hold delay parameter to the desired delay time; 2. assign the hold delay function to the Press action of a key; 3. assign the emergency procedure to the Hold action of the same key used in step 2. Enter "Off" if no time-out is required.

Start del. required
Range: Disable, Enable
Determines whether a decoded sequence with a matching decode definition is accepted with leading digits (Disable) or is only accepted if preceded by a no-tone period of silence (Enable).

Digit entry method (multi-channel models only)
Range: Replace, Overwrite
If the Digit entry method is set to Overwrite, the selected selcall address overwrites the previously selected address from right to left. If set to Replace, the previously selected selcall address is first replaced by the default transmit address for the selected channel and then overwritten from right to left.

Copy from default tx
Range: Disable, Enable
If set to "Enable" the keypad-selectable selcall address is overwritten by the Default Tx address each time the user changes the channel number through selection or during scanning. If set to "Disable" remains the same.

6.6 sYstem parameters

The System parameters menu serves to configure system-dependent parameters.
By creating multiple system blocks, you are able to configure the transceiver
for operation in different systems. The current section describes all
parameters of the System parameters menu.

Selcall toneset standard
Range: ZVEI, CCIR, EEA, PZVEI, DZVEI, PCCIR, PDZVEI, ZVEI-2, EIA, Natel,
AP-369, Kenwood
Determines which selcall toneset standard is used for decoding selective call
messages. Note that the selcall standard used for encoding is defined within
the encode formats. The Philips EEA derivative can be configured by
selecting PCCIR and choosing a 40 ms duration per tone for encoding.

Receive gap period
Range: 0 .. 640 ms
Step size: 5 ms
Defines the period of time the selcall decode algorithm requires a 'no-tone'
condition after the last valid tone has been received. The recommended value
for the receive gap period is 1.5 times the duration per tone, for example,
150 ms for CCIR 100 ms.

Selectable selcall digits
Range: None, One, Two, Three, Four, Five
Defines the number of digits of the key selectable address that may be
changed by the user. These keypad selectable digits are normally included in
the transmit selective call formats.

Selectable status digits
Range: None, One, Two, Three, Four, Five
Defines the number of digits of the key selectable status number that may be
changed by the user. These key selectable digits are normally included in
the transmit selective call formats.

Busy symbol function
Range: Carrier, QT/DQT
Determines the use of the busy symbol on the display. For QT/DQT driven
repeater operation, selection "QT/DQT" should be used. For all other
applications, selection Carrier is preferred.

Busy LED (portable only)
Range: Disable, Carrier, QT/DQT
Determines the use of the busy LED on the display. For QT/DQT driven
repeater operation, selection QT/DQT should be used. For all other
applications, selection "Carrier" is preferred.

Return-to-standby mode
Range: Disable, Tx-only, Tx/Rx
The Return-to-standby mode is activated if this parameter is set to "Tx-only"
or "Tx/Rx". The "Tx-only" selection re-triggers the Rts timer only when
transmitting, the "Tx/Rx" selection re-triggers the Rts timer both when
transmitting and receiving. The Rts facility prevents unnecessarily use of
the transceiver.

Automatic close
Range: None, Two, Three, Four
Determines the number of digits that have to match the Primary Rx address in order to close the transceiver. When None is selected, the automatic close facility is disabled. It is recommended to enter the highest number of digits possible for operation of Automatic close, for example, three for a 5-tone decode format with the first three digits fixed and two variable digits.

Monitor function
Range: Selcall, QT/DQT, Both, Reset, Disable
Determines the function of the monitor-key. If set to "Selcall", the monitor-key operates as selcall open/close. If set to "QT/DQT", the monitor-key operates as QT/DQT monitor. If set to "Both", the monitor-key operates as a combined selcall and QT/DQT monitor. If set to "Reset", the monitor-key resets the selcall mute. If set to "Disable", the monitor-key has no function.

Drop out delay time (multi-channel models only)
Range: 0.5 .. 15.0 s
Step size: 0.5 s
Selects the period of time after which scanning is resumed if no activity is detected anymore. Normally, this parameter is set to around 1 second.

TX dwell time (multi-channel models only)
Range: 0.5 .. 15.0 s
Step size: 0.5 s
Determines the period of time for scan to resume after a transmission is completed and the correct signal drops out.

Scan dwell time (multi-channel models only)
Range: Off, 1 .. 255 s
Step size: 1 s
Determines the period of time after which scanning is resumed while continuously detecting activity on the channel. If set to "Off", the scan dwell facility is disabled.

Scan configuration (multi-channel models only)
Range: Carrier, QT/DQT, Selcall, Both, Selcall-st, Both-st, No carrier
Determines the operating mode of scanning defined for the current system group. If set to "Carrier", the transceiver stops on a channel when it receives a carrier. If set to "QT/DQT", the transceiver stops on receiving a valid QT tone or DQT code (defined per channel as QT/DQT decode). If set to "Selcall", the transceiver stops on receiving a tone that matches the first tone of the Primary Rx address defined for that channel. If set to "Both", the transceiver stops on receiving a valid QT/DQT and first tone simultaneously. Operation of "Selcall-st" and "Both-st" are similar to "Selcall" and "Both", but the transceiver remains on the channel until the transceiver is operated. The "No-carrier" selection allows scanning for a channel which is not used (opposite of carrier scanning).

Group digit selectable (multi-channel models only)
Range: Disable, Enable
Determines if group digit selection is possible using the Digit 1x-, Digit 10x-, and Digit Up-keys (Enable) or if group digit selection is not allowed (Disable).

System formats / Decode format
Range: [Disable], <defined decode formats>
Selects the decode format used to decode incoming selective call messages.
Note that the decode format itself can include links to other decode formats
to allow decoding of multiple formats. Selection of a specific decode format
definition is only possible if the definition has already been entered within
the decode format editor (Advanced options/Encode formats).

System formats / Encode #1
Range: [Disable], <defined encode formats>
Selects the encode format to be executed when activating key function Encode
#1, as defined in the key definition menu. Suggested use: normal call.
Selection of a specific encode format definition is only possible if the
definition has already been entered within the encode format editor.

System formats / Encode #2
Range: [Disable], <defined encode formats>
Selects the encode format to be executed when activating key function Encode
#2, as defined in the key definition menu. Suggested use: free-dial selcall.
Selection of a specific encode format definition is only possible if the
definition has already been entered within the encode format editor.

System formats / Encode #3
Range: [Disable], <defined encode formats>
Selects the encode format to be executed when activating key function Encode
#3, as defined in the key definition menu. Suggested use: free-dial DTMF.
Selection of a specific encode format definition is only possible if the
definition has already been entered within the encode format editor.

System formats / Encode #4
Range: [Disable], <defined encode formats>
Selects the encode format to be executed when activating key function Encode
#4, as defined in the key definition menu. Suggested use: single-tone
transmission. Selection of a specific encode format definition is only
possible if the definition has already been entered within the encode format
editor.

System formats / Encode #5
Range: [Disable]. <defined encode formats>
Selects the encode format to be executed when activating key function Encode
#5, as defined in the key definition menu. Suggested use: status call.
Selection of a specific encode format definition is only possible if the
definition has already been entered within the encode format editor.

System formats / Encode #6
Range: [Disable], <defined encode formats>
Selects the encode format to be executed when activating key function Encode
#6, as defined in the key definition menu. Suggested use: emergency call.
Selection of a specific encode format definition is only possible if the
definition has already been entered within the encode format editor.

System formats / Encode PTT-press
Range: [Disable], <defined encode formats>
Selects the encode format to be executed when the Push-To-Talk switch is
pressed. This encode format can be used to send an ANI message every time
the PTT switch is pressed. Note that also for normal PTT operation a valid
encode format must be entered here; necessary to activate the microphone.
Selection of a specific encode format definition is only possible if the
definition has already been entered within the encode format editor.

System formats / Encode PTT-release
Range: [Disable], <defined encode formats>
Selects the encode format to be executed when the Push-To-Talk switch is
released. This encode format can be used to send an ANI message every time
the PTT switch is released, or to send a QT or DQT trailing silence or tone.
Selection of a specific encode format definition is only possible if the
definition has already been entered within the encode format editor.

System formats / Encode DTMF overdial
Range: [Disable], <defined encode formats>
Selects the encode format to be executed when pressing a numerical key, *, #
or ABCD-key while the PTT switch is pressed for speech conversation. Using a
suitable encode definition, this facility can be used to provide DTMF
overdialing. Selection of a specific encode format definition is only
possible if the definition has already been entered within the encode format
editor.

System formats / Encode DTMF direct
Range: [Disable], <defined encode formats>
Selects the encode format to be executed when pressing a numerical key, *, #
or ABCD-key while in DTMF entry mode. The DTMF entry mode can be defined as
default by assignment of selection DTMF for parameter "Keypad operation".
Using a suitable encode definition, this facility can be used to provide DTMF
direct dialing. Selection of a specific encode format definition is only
possible if the definition has already been entered within the encode format
editor.

System formats / Encode channel select
Range: [Disable], <defined encode formats>
Selects the encode format to be executed when changing to a radio channel
linked to the current system group. This encode function can be used to
customize some channel or system group characteristics. Selection of a
specific encode format definition is only possible if the definition has
already been entered within the encode format editor.

System formats / Encode on hook (mobile only)
Range: [Disable], <defined encode formats>
Selects the encode format to be executed when the microphone is put on hook.
Selection of a specific encode format definition is only possible if the
definition has already been entered within the encode format editor.

System formats / Encode off hook (mobile only)
Range: [Disable], <defined encode formats>
Selects the encode format to be executed when the microphone is taken from
the hook (off-hook). Selection of a specific encode format definition is
only possible if the definition has already been entered within the encode
format editor.

6.7 Advanced options

The Advanced options menu allows you to set Decode and Encode formats, input
a Status or Queue message, and set the Kenwood toneset.

6.7.1 Decode formats

Decode formats are series of instructions describing the contents of
selective call messages to be received, and the actions to be executed if the
incoming message matches the defined sequence.

The sequences of instructions can be entered, edited and compiled within the
KPG-32D program. A suitable name can be assigned to every defined decode
format to enable reference to these formats for each system group and to
other decode formats and/or encode formats. It is possible to define up to
64 decode formats.

In the table below, all decode format instructions are described briefly and
grouped according to their function.

```
Mnemonic        |Description
------------------------------------------------------------------
CMP seq         |Compare to sequence; immediate or indirect
STO index       |Store digits for queuing
GRPN            |No group digit decode
GRPA            |Decode A-tone as group digit
GRP0            |Decode 0-tone as group digit
GRP0A           |Decode both A-tone and 0-tone as group digit
MONO            |Monitor open
MONF            |Monitor open, "MON" blinks
MONC            |Monitor close
RSTUN           |Remote stun
RVIVE           |Remote revive
RKILL           |Remote kill
EMGOF           |Emergency mode off
REPOF           |Repeat sequence off
QUEUE           |Queue contents of temporary buffer with channel no.
QUE1            |Queue buffer, with channel, duplicate allowed, FILO
QUE2            |Queue buffer, w/o channel, duplicate allowed, FILO
QUE3            |Queue buffer, with channel, no duplicate allowed, FILO
QUE4            |Queue buffer, w/o channel, no duplicate allowed, FILO
QUE5            |Queue buffer, with channel, duplicate allowed, FIFO
QUE6            |Queue buffer, w/o channel, duplicate allowed, FIFO
QUE7            |Queue buffer, with channel, no duplicate allowed, FIFO
QUE8            |Queue buffer, w/o channel, no duplicate allowed, FIFO
DISPQ           |Select queue mode, show first entry
BEEP num        |Sound alert for individual and group calls
BEEPI num       |Sound alert for individual calls only
BEEPG num       |Sound alert for group calls only
EXTAL alertseq  |Controls external alert output (mobile only)
XPASS           |Exit if individual or group call match
ERASE time      |Erases contents temporary buffer after period of time
CKSAT           |Check for SAT decode
CLOSE           |Check if decode triggered by Return-to-Standby
ACK             |Show ACK sign
ENCA enc        |Execute encode format if individual or group call
```

```
ENCI enc        |Execute encode format if individual call
ENCG enc        |Execute encode format if group call
DECA dec        |Execute encode format if individual or group call
DECI dec        |Execute encode format if individual call
DECG dec        |Execute encode format if a group call
DECF dec        |Execute encode format if call fail
DECAT time dec  |Trigger decode format for time ms if individual or group call
DECIT time dec  |Trigger decode format for time ms if individual call
DECGT time dec  |Trigger decode format for time ms if group call
SSTO            |Status store
DISPM           |Select queue message mode
```

The parameters mentioned are listed in the table below.

```
Parameter |Description
---------------------------------------------------------
seq       |Sequence of immediate and/or indirect digits:
          |#dig       immediate digit
          |^Dptr      Default Tx address
          |^Pptr      Primary Rx address
          |^Sptr      Secondary Rx address
          |^Tptr      Third Rx address
          |^Qptr      temporary queue entry
          |^Uptr      selectable status address
          |^Mptr      miscellaneous digits
          |^Kptr      selectable selcall address
dig       |Digit: 0 .. 9 and A .. F
ptr       |Pointer: 1 .. 5
index     |Index: 1 .. 5
num       |Alert beep number: 0 .. 46
enc       |Encode format
dec       |Decode format
time      |Standard time: 0 .. 2550 ms in 10 ms steps
alertseq  |External alert sequence: 00000000 .. 11111111
```

Below, the instruction commands are listed in alphabetical order and explained in more detail.

ACK
Upon a matching sequence, executing the ACK instruction causes the plus sign on the display to be shown.

BEEP 'num'
Upon a matching sequence, BEEP alerts the user to an incoming call. Both individual and group calls ('A' digits in the received sequence) are accepted. The valid range of "num" is 0 to 46. See appendix G for an overview of available alert tones.

BEEPG 'num'
Upon a matching sequence, BEEPI alerts the user to an incoming call with
group digits. The valid range of "num" is 0 to 46. See appendix G for an
overview of available alert tones.

BEEPI 'num'
Upon a matching sequence, BEEPI alerts the user to an individually-addressed
incoming call. The valid range of "num" is 0 to 46. See appendix G for an
overview of available alert tones.

CKSAT
The CKSAT instruction checks whether a valid DQT or QT tone is received on
the radio channel. If not, or a wrong QT tone or DQT code is received, the
match flag will be reset. If no DQT or QT is programmed for the selected
radio channel, the match flag will not be affected. The CKSAT instruction
can be used to check whether a valid QT tone or DQT code is received along
with the received selcall sequence.

CLOSE
The CLOSE instruction sets the match flag if this decode format is triggered
by the Return-to-standby listen or active timer expiring. If not, the match
flag will be reset.

CMP 'seq'
The CMP instruction enables the comparison of decoded digits and defined
digits. Defined digits can be immediate digits, which are fixed in the
decode format, or indirect digits, which are stored as channel parameters,
entered addresses or status digits. Immediate digits are entered as the
pound sign (#) plus one or more digits. Indirect digits are entered as ^-
sign plus the pointer character and one or more indexes. In one sequence, up
to fifteen digits can be defined, allowing decoding of up to fifteen digit
sequences. CMP and STO instructions can be alternated to define queue
formats.

DECA 'dec'
Upon a matching sequence, for both individual and group calls, DECA starts
another decode format. The DEC range of instructions enables the linkage of
decode sequences when the size of one decode format is insufficient, or when
further decoding of the received sequence is required. String "dec" must be
replaced by the name of a previously created decode format.

DECAT 'time' 'dec'
Upon a matching sequence, either with or without group digits, DECAT
activates another decode format for the number of milli-seconds specified by
"time". The timed DEC instructions are used to process multiple selcall
sequences, such as 2*5-tone or 3*5-tone. String "dec" must be replaced by
the name of a previously created decode format.

DECF 'dec'
If no matching sequence is found, DECF starts execution of another decode
format. DECF is normally used when the size of a decode format is
insufficient. String "dec" must be replaced by the name of a previously
created decode format.

DECG 'dec'
Upon a matching sequence with one or more group digits, DECG starts the
execution of another decode format, which is indicated by "dec". String
"dec" must be replaced by the name of a valid decode format.

DECGT 'time' 'dec'
Similar to DECAT, but activated only if the received sequence contains one or
more group digits.

DECI 'dec'
Upon a matching sequence without group digits, DECI starts the execution of
another decode format, which is indicated by dec. String "dec" must be
replaced by the name of a valid decode format.

DECIT 'time' 'dec'
Similar to DECAT, but activated only if the received sequence is without
group digits.

DISPM
Selects queue entry from within decode formats, thus the queue message
immediately pops up when a call is received. DISPM is ignored when no queue
entries are available.

DISPQ
Select queue entry from within decode format, thus the queued identity
immediately pops up when a call is received. DISPQ is ignored when no queue
entries are available.

EMGOF
Upon a matching sequence, EMGOF switches off the emergency state. The
emergency state can be activated by an encode format.

ENCA 'enc'
Upon a matching sequence for both individual and group calls, ENCA starts the
execution of a specific encode format. The ENC range of instructions are
most frequently used to assign a 'transpond' transmission, as an
acknowledgment to a successfully received call. String "enc" must be
replaced by a previously created encode format name.

ENCG 'enc'
Upon a matching sequence with one or more group digits, ENCG starts the
execution of a specific encode format. String "enc" must be replaced by the
name of a previously created encode format.

ENCI 'enc'
Upon a matching sequence without group digits, ENCI starts the execution of a
specific encode format. For transpond applications, the ENCI instruction is
more suitable than ENCA or ENCG, because it only responds to individual
calls. String "enc" must be replaced by the name of a previously created
encode format.

ERASE 'time'
Upon a matching sequence, the contents of the temporary buffer (filled by STO
instructions) will be erased after the specified period of time. Can be used
to decode 2*5-tone formats with transmitting order [own-ID] [selected-ID] (as
seen from the transmitting transceiver).

EXTAL 'alertseq' (mobile only)
On a matching sequence and when the external alert facility is enabled by the
user, the externally connected relay to control the horn or lights will be
activated according to the specified rhythm. The rhythm 'alertseq' consists
of a series of eight 0s or 1s specifying the on/off slots of 500ms
(0: off, 1: on). For example, 'alertseq' 11011011 activates the external
alert output three times with a 1 second duration, with a pause of 0.5
seconds between each output.

GRP0
While executing the CMP instructions that follow, the 0-tone is recognized as
a group digit (standard utilized in some Motorola systems).

GRP0A
While executing the CMP instructions that follow, both the 0-tone and the A-
tone will be recognized as group digits (both international and Motorola-
specific group tone decoding standards).

GRPA
While executing the CMP instructions that follow, the A-tone is recognized as
a group digit (international standard for group tone decoding).

GRPN
While executing the CMP instructions that follow, no group tones will be
recognized.

MONC
Upon a matching sequence, MONC causes the selcall monitor function to close.

MONF
The MONF instruction is similar to MONO, but also causes the selcall monitor
"MON" to blink; this alerts the user visually that a call has been received.

MONO
If the incoming selcall sequence matches the preceding CMP/STO definition,
the MONO instruction causes the transceiver to open the selcall monitor. The
user can then hear the conversation on the channel.

QUEUE
On a matching sequence, QUEUE stores digits prepared by previously executed
STO instructions and the currently selected channel to the queue.

QUE1
Upon a matching sequence, QUE1 (same as QUEUE) stores digits prepared by
previously executed STO instructions to the queue. The currently selected
channel is stored. Duplicated entries are allowed. The entry is stored in
FILO order (First-In, Last-Out). See the chart in section 6.7.2 for a direct
comparison of QUE1 to QUE8 instructions.

QUE2
Upon a matching sequence, QUE2 stores digits prepared by previously executed
STO instructions to the queue. The currently selected channel is not stored.
Duplicated entries are allowed. The entry is stored in FILO order (First-In,
Last-Out).

QUE3
Upon a matching sequence, QUE3 stores digits prepared by previously executed
STO instructions to the queue. The currently selected channel is stored.
Duplicated entries are not allowed. The entry is stored in FILO order
(First-In, Last-Out).

QUE4
Upon a matching sequence, QUE4 stores digits prepared by previously executed
STO instructions to the queue. The currently selected channel is not stored.
Duplicated entries are not allowed. The entry is stored in FILO order
(First-In, Last-Out).

QUE5
Upon a matching sequence, QUE5 stores digits prepared by previously executed
STO instructions to the queue. The currently selected channel is stored.
Duplicated entries are allowed. The entry is stored in FIFO order (First-In,
First-Out).

QUE6
Upon a matching sequence, QUE6 stores digits prepared by previously executed
STO instructions to the queue. The currently selected channel is not stored.
Duplicated entries are allowed. The entry is stored in FIFO order (First-In,
First-Out).

QUE7
Upon a matching sequence, QUE7 stores digits prepared by previously executed
STO instructions to the queue. The currently selected channel is stored.
Duplicated entries are not allowed. The entry is stored in FIFO order
(First-In, First-Out).

QUE8
Upon a matching sequence, QUE8 stores digits prepared by previously executed
STO instructions to the queue. The currently selected channel is not stored.
Duplicated entries are not allowed. The entry is stored in FIFO order
(First-In, First-Out).

REPOF
Upon a matching sequence, REPOF stops repeating encode formats when activated
from an encode format (section 6.7.2). Applications of the REPOF
instructions can be found in decode formats linked to encode formats when an
acknowledge message is necessary, e.g. an emergency call.

RKILL
Upon a matching sequence, RKILL destroys the contents of the EEPROM, so that
the transceiver must be returned to the dealer for reprogramming. This
facility is normally used for security reasons when the transceiver has been
stolen or is missing.

RSTUN
Upon a matching sequence, RSTUN causes the transceiver to lock operation of
PTT, mute the receiver, and show 'LOC2' on the display. This remote stun
facility can be used to take a transceiver out of service for commercial or
security reasons, e.g. for not paying an invoice or when the transceiver has
been stolen or is missing.

RVIVE
Upon a matching sequence, RVIVE revives a transceiver previously taken out of
service with remote stun (RSTUN).

SSTO
Stores received status in the status queue.

STO 'index'
STO instructions serve to copy received digits to a temporary buffer for
further processing or queuing. Any digit value is accepted, except no-tone
(F). The index pointer points to a position within the internal 5-digit
buffer. This 5-digit buffer can be copied to the queue using the QUEUE
instruction. STO and CMP instructions can be alternated in any order to
allow single digits to be used for further processing and queuing.

XPASS
Upon a matching sequence, XPASS aborts execution of the currently loaded
decode format.

6.7.2 Encode formats

An Encode format is a series of instructions which describe the actions and
selective call tones and DTMF tones to be transmitted in a sequence. The
concept is very similar to that of decode formats, described in the previous
section.

Like the decode formats, the instruction sequences of the encode formats can
be entered, edited and compiled within the program. Every sequence has a
name attached to it. The maximum number of encode formats is 64.

In the table below, all encode format instructions are described briefly and
grouped according to their function.

```
Mnemonic         |Description
-------------------------------------------------------------
SEND seq         |Send sequence of digits, immediate or indirect
SLEN ofs         |Send length indicator plus offset
SCHK             |Send checksum digit
SDIAL            |Send free-dialed string of digits
TXS              |Switch to transmit, selcall path
TXD              |Switch to transmit, DTMF path
TXM              |Switch to transmit, microphone path
RX               |Switch to receive mode
TXP              |Switch to transmit using programmed frequency
TXF rf-freq      |Switch to transmit using in-line frequency
RXP              |Switch to receive using programmed frequency
RXF rf-freq      |Switch to receive using in-line frequency
SCTP             |SAT transmit using programmed frequency
SCT st-tone      |SAT transmit using in-line QT or DQT code
SCRP             |SAT receive using programmed frequency
SCR st-tone      |SAT receive using in-line QT or DQT code
SCOFF            |SAT transmit off
DTAIL            |DQT tail tone transmission
SELCH channel    |Select radio channel
SELSC scangr     |Select scan group
TSET toneset     |Select toneset
TONE af-freq     |Send single tone
LEN xtime        |Select duration per tone
DEL xtime        |Execute delay
RIGN stime       |Receive ignore during period of time
RACK stime dec   |Trigger acknowledge receive during period of time
RSMS stime       |Resume after short period of time (10 .. 2550 ms)
RSML ltime       |Resume after long period of time (1 .. 255 s)
RSTDL            |Restart encode format if dial digit available
BEEP num         |Sound alert tone sequence
CLACK            |Clear ACK sign
EMGON            |Activate emergency mode
DIFIX            |Display fix
TEXT text        |Output text on display
TXTOF            |Restore normal display operation
ENTTM ltime      |Assign entry timeout
WAITR            |Wait for key release
TPE              |Transparency enable
TPD              |Transparency disable
ERRX0            |Error alert on exit off
```

```
ERRX1          |Error alert on exit on
REP rep        |Repeat sequence for rep times
SELT           |Select tone mode
SELD           |Select free dial mode
SELS           |Select status entry mode
RTSL           |Reload Rts with listen or active time-out
RTSA           |Reload Rts with active time-out
RTSO           |Reload Rts only when in active mode
STRTS          |Start scanning
STRTP          |Start priority scan
STOPS          |Stop scanning
STOPP          |Stop priority scan
OPEN           |Select selcall mute open
CLOSE          |Select selcall mute close
PREFA          |Select preference channel when in scan mode
PREFS          |Select preference channel when in scan mode and scanning
SPREV          |Select previously selected channel when in scan mode
SBUSY          |Skip encode digits if channel busy
XCLOS          |Exit if selcall mute closed
XOPEN          |Exit if selcall mute open
XSCAN          |Exit if in scan mode
XPRI           |Exit if in priority scan mode
XCARR          |Exit if carrier detected
XCTCN          |Exit if no or wrong QT/DQT detected
XCTCW          |Exit if no carrier, no or wrong QT/DQT detected
XSAT st-tone   |Exit when the QT/DQT specified with 'st-tone' is received
XSENS          |Exit if scanning, but not stopped on channel
XIDLE          |Exit if Return-to-standby idle mode
XLIST          |Exit if Return-to-standby idle or listen mode
XNOT           |Exit if not in transfer mode (mobile only)
SELMC          |Select queue message and status message
SCPH           |QT phase 180 degrees
SELM           |Select status message
SELC           |Select queue message
SENDC          |Send queue
SENDS          |Send status
ENC enc        |Execute encode format
```

The parameters mentioned are listed in the table below.

```
Parameter |Description
-------------------------------------------------------------------
seq       |Sequence of immediate and/or indirect digits:
          |#dig    immediate digit
          |^Dptr   Default Tx address
          |^Pptr   Primary Rx address
          |^Sptr   Secondary Rx address
          |^Tptr   Third Rx address
          |^Qptr   temporary queue entry
          |^Uptr   selectable status address
          |^Mptr   miscellaneous digits
          |^Kptr   selectable selcall address
dig       |Digit: 0 .. 9 and A .. F
ptr       |Pointer: 1 .. 5
ofs       |Offset: 0 .. 9
dec       |Decode format
```

```
enc        |Encode format
re-freq    |Transceiver frequency: dependent on selected range
af-freq    |Audio frequency: 300 .. 3000 Hz
st-tone    |QT frequency (67.0 to 250.3) or DQT code (N or I)
toneset    |ZVEI, CCIR, EEA, PZVEI, DZVEI, PCCIR, PDZVEI,
           |ZVEI-2, EIA, Natel, AP-369, Kenwood
xtime      |Extended time: 1 .. 7000 ms in 1 ms units
stime      |Standard time: 0 .. 2550 ms in 10 ms units
ltime      |Long time: 0 .. 255 seconds in 1 second units
num        |Alert beep number: 0 .. 46
rep        |Repeat factor: 0 .. 255
text       |String of characters
channel    |Channel number: 1 .. 250
scangr     |Scan group number or direction: 0 .. 9, UP, DOWN
```

Below, the instruction commands are listed in alphabetical order and
explained in more detail.

BEEP 'num'
Alerts the user by a specific alert tone sequence. Parameter "num" selects
the beep sequence, ranging from 0 to 46. See appendix G for an overview of
available alert tones.

CLACK
Clears the ACK symbol on the display.

CLOSE
Forces selcall mute to closed state. Note that the related XCLOS and XOPEN
instructions will test the selcall mute state when the encode format is
started, not at the time when the XCLOS or XOPEN instruction is executed.

DEL 'xtime'
Causes the execution of the encode sequence to be suspended for a period of
time, defined by parameter "xtime". The range of "xtime" is 1 to 7000 ms in
1 ms steps, thus allowing a precise pause duration of up to 7 seconds. The
DEL instruction can be used to insert an LET (Link Establishment Time) or an
inter sequence gap e.g. 2*5-tone formats.

DIFIX
Activates the emergency mode with the display contents frozen. In the
emergency mode, selcall encoding and decoding continues, but activity is not
seen on the display or LED, and the speaker is muted. Deactivation of the
emergency mode is possible only by switching off the equipment, or by
execution of EMGOF from a decode format.

DTAIL
Triggers transmission of the standard DQT tail tone of 135 Hz. This tail
tone is transmitted after speech transmission for rapid switch-off of the DQT
decoder within the listening transceiver. In a PTT release encode format,
the following format will send the DQT tail tone 200 ms before the end of
transmission: DTAIL DEL 200 RX.

EMGON
Activates the emergency mode. In the emergency mode, selcall encoding and
decoding continue, but activity is not seen on the display, or LED, and the
speaker is muted. Deactivation of the emergency mode is possible only by
switching off the equipment, or by execution of EMGOF from a decode format.

ENC 'enc'
Executes other encode formats that are indicated by "enc". String "enc" must
be replaced by the name of a previously created encode format.

ENTTM 'ltime'
Assigns the entry timeout. Parameter "ltime" selects the entry timeout,
ranging from 0 to 255 seconds in 1 second steps. Note that value 0 defines
an infinite timeout, thus the selected entry mode will remain selected until
a key-Press reloads the entry timer with the standard number entry timeout.

ERRX0
After execution of instruction ERRX0, exiting an encode instruction due to
one of the exit conditions (for example, instruction XOPEN) prevents the
transceiver from emitting an error alert.

ERRX1
After execution of instruction ERRX1, exiting an encode instruction due to
one of the exit conditions (for example, instruction XOPEN) causes the
transceiver to emit an error alert.

LEN 'xtime'
Defines the duration per tone for TONE, SEND, SLEN, SCHK and SDIAL
instructions. The range of "xtime" is 1 to 7000 ms in 1 ms steps, allowing a
precise tone duration of up to 7 seconds.

OPEN
Forces selcall mute to the open state. Note that the related XCLOS and XOPEN
instructions will test the selcall mute state when the encode format is
started, not at the time when the XCLOS or XOPEN instruction is executed.

PREFA
Causes the transceiver to select the Preference channel when scanning is
activated. The PREFA instruction can be used to choose a predefined channel
to transmit on when the PTT switch is pressed while in scanning mode,
regardless of whether scanning has stopped temporarily.

PREFS
Causes the transceiver to select the Preference channel when checking
channels in the scanning mode. The PREFS instruction can be used to choose a
predefined channel to transmit on when the PTT switch is pressed while in
scanning mode but not stopped on a channel.

RACK 'stime' 'dec'
Used for triggering a decode format when a full selective call sequence is
received within a specified period of time. This period is defined by
"stime", which ranges from 0 to 2550 ms in 10 ms steps. String "dec"
determines which decode format will be triggered. The RACK instruction can
be used to check whether a transpond call is returned from the called unit,
or to check whether a call is acknowledged before retrying (see also REP
instruction). If no ACK instruction is triggered by a linked decode format,
the minus sign will be shown on the display after the time-out period has
elapsed.

REP 'rep'
Can be used to repeat the encode format for a specific number of times.
Parameter "rep" defines how often the current encode format is repeated. Use
RSMS or RSML to restart a sequence after the defined period of time. Use the
decode format instruction REPOF to stop the repetition of encode sequences
before the end of the programmed period.

RIGN 'stime'
Causes the auto-close feature to be disabled for a specified period of time.
The range of "stime" is 0 to 2550 ms in 10 ms steps. This instruction can be
used in combination with the 'Automatic close' feature to prevent the unit
from closing automatically when expecting a transpond call (acknowledgment
call from another unit when calling that unit).

RSML 'ltime'
After passing instruction RSML, execution of the encode sequence is suspended
and restarted from the beginning after a specified period of time. This
period is defined by "ltime", which ranges from 0 to 255 seconds in 1 second
steps.

RSMS 'stime'
After passing instruction RSMS, execution of the encode sequence is suspended
and restarted from the beginning after a specified period of time. This
period is defined by "stime", which ranges from 0 to 2550 ms in 10 ms steps.

RSTDL
Repeats the currently executed encode format if more dialing digits are
available in the overdial/direct dial digit buffer. This instruction can be
used to retrieve still available digits from this buffer for DTMF
overdialing, even if the PTT switch has already been released.

RTSA
Causes the Return-to-standby state to be set to active, and resets the
Return-to-standby timer to the active period of time.

RTSL
Causes the Return-to-standby timer to be set to the listen or active period
of time, depending on the current Return-to-standby state.

RTSO
Causes the Return-to-standby timer to be set to the active period of time if already in the active Return-to-standby state. If not in the active mode, the timer will not be set.

RX
Switches to receive mode, after which all mute functions apply.

RXF 'rf-freq'
Switches to receive mode, using the in-line specified RF frequency. The specified frequency must be within the selected RF band. For example, in a VHF transceiver, the instruction RXF 149.0500 will cause the transceiver to receive on 149.0500 MHz.

RXP
Switches to receive mode using the programmed frequency for the selected channel.

SBUSY
Instruction SBUSY skips transmission of digits following this instruction if a carrier is present at the time the encode format is started.

SCHK
Sends a checksum digit, the value of which is calculated as the sum of all previous digits MOD 10. The SCHK instruction can also be used to build a data-packet for transmitting dialing information.

SCOFF
Instruction SCOFF switches off QT transmission. In a PTT-release encode format, a useful application for SCOFF is to switch QT off about 300 ms before transmission is ended (sequence 'SCOFF DEL 300 RX'); this will prevent the trailing noise to be heard on the receiving equipment if QT decoding is used as well.

SCPH
Causes the QT sine wave to skip 180 degrees of phase. This will mute the receiving equipment of the other party quicker than only switching off QT. In a PTT release encode format, the following format will cause the QT sine wave to skip 180 degrees of phase 150 ms before the end of transmission: SCPH DEL 150 RX.

SCR 'st-tone'
Activates QT/DQT receive, using the in-line specified QT receive frequency or DQT code. The QT frequency must be entered as a frequency between 67.0 and 250.3 Hz; a normal DQT code as D, three digits, N; and an inverted DQT code as D, three digits, I.

SCRP
Activates QT/DQT receive, using the programmed QT receive frequency or DQT code for the selected channel.

SCT 'st-tone'
Activates QT/DQT transmit, using the in-line specified QT transmit frequency
or DQT code. The QT frequency must be entered as a frequency between 67.0
and 250.3 Hz, a normal DQT code as D plus three digits, and an inverted DQT
code as I plus three digits.

SCTP
Activates QT/DQT transmit, using the programmed QT transmit frequency or DQT
code for the selected channel.

SDIAL
Sends all the digits that are entered as a dialing string. The dialing
string can contain up to 28 digits. The SDIAL instruction is used to
transmit this dialing information. It is recommended to use SLEN and SCHK in
addition to SDIAL, to minimize the occurrence of errors due to bad signaling
conditions.

SELC
Instruction SELC puts the unit in Queue message mode. In Queue message mode,
the user can select the address to be sent by the SENDC instruction.
Pressing the message key toggles between the address number and the address
name. The address name, previously programmed via the FPU – Advanced
Options/Queue message, scrolls from right to left. Turning the channel knob
scrolls through the list. Press the "*" key to assign the currently
displayed address number or name to the SENDC instruction and continue with
the encode format.

SELCH 'channel'
Selects a specific radio channel. Parameter "channel" specifies the radio
channel to be selected in the range of 1 to 250. Note that the number in the
"Ch No." column of the Channel Information window should be used and not the
programmed name.

SELD
Selects the dialing string entry mode. After execution of SELD, the display
will be cleared and any number up to 28 digits can be entered from the
keypad. Execution of the encode format is resumed after the "*" key is
pressed. The contents of the dial buffer can be transmitted later using the
SDIAL instruction.

SELM
Instruction SELM puts the unit in Status message mode. In Status message
mode, the user can select the status number to be sent by the SENDS
instruction. Pressing the message key toggles between the status message and
the status number. The status message, previously programmed via the FPU –
Advanced Options/Status message, scrolls from right to left. Turning the
channel knob scrolls through the list (01 to 32). Press the "*" key to
assign the currently displayed status message or number to the SENDS
instruction and continue with the encode format. Note that only the number
(01 to 32) associated with the status message is sent.

SELMC
Instruction SELMC combines both SELM and SELC. By using this instruction the
user can first select which message to send, then select who to send the
message too.

SELS
Selects the status digit entry mode. After execution of SELS, the display
will show 'St _', allowing entry of one digit in the range of 0 to 9. If
necessary, this digit can be overwritten or erased by pressing the C-key.
After selection, pressing "*" key continues execution of the current encode
format.

SELSC 'scangr'
Selects a specific scan group, or selects the next or previous available scan
group. The valid range for "scangr" is 0 to 9 for direct scan group
selection, UP for next scan group selection and DOWN for selection of the
previous scan group.

SELT
Causes the text 'TONE' to be shown on the display. The instruction can be
used to ask for a confirmation of single-tone transmission using the "*" key.

SEND 'seq'
The SEND range of instructions is used to transmit selective call digits and
DTMF tones. The digit or tone values can be fixed in the encode format
(immediate digits), or they can be retrieved from the internal tables
(indirect digits). Immediate digits are entered in a format consisting of
the pound sign (#) followed by one or multiple digits. Indirect digits are
entered as ^-sign plus the pointer character and one or more indexes. One
sequence can contain up to 64 instructions, thus allowing approximately 50
tones to be sent in a sequence. Examples of immediate and indirect reference
of digits can be found in section 6.7.1, under the CMP command.

SENDC
Sends the queue message selected using SELC or SELMC.

SENDS
Sends the status message selected using SELM or SELMC.

SLEN 'ofs'
Causes a digit to be sent as selcall or DTMF, the value of which is
determined from the length of the dialed number string. The digit value is
calculated as (Length + Offset) MOD 10, and thus has a value ranging from 0
to 9. The SLEN instruction can be used to build a data-packet to transmit
dialing information from the transceiver to an infrastructure connected to
the PSTN.

SPREV
Can be used to choose the channel that had been selected before scanning was
activated. This instruction can be used to switch off scanning fully from an
encode format, as if switching off scanning manually.

STOPP
Switches off priority scanning. Note that the related XPRI instruction will
test the priority scan state when the encode format is started, not at the
time when the XPRI instruction is executed.

STOPS
Switches off scanning. Note that the related XSCAN instruction will test the
scanning state when the encode format is started, not at the time when the
XSCAN instruction is executed.

STRTP
Switches on Priority scanning.

STRTS
Switches on scanning.

TEXT 'text'
Outputs text to the display. All characters can be entered; however, some
characters will be more difficult to read. Characters are shown on the large
4-digit display section and are shifted from the right to the left. The
speed of shifting characters on the display can be set using the LEN command.

TONE 'af-freq'
Allows transmission of any tone between 300 and 3000 Hz. The length of the
tone can be defined using the LEN instruction, which must be inserted before
the TONE instruction. For example, encode sequence 'LEN 1200 TONE 1550'
sends a tone of 1550 Hz for 1.2 seconds. Single-tone transmission is
frequently used to operate repeaters or for a group call or all-close in
certain selective call systems.

TPD
Deactivates the transparency mode that is activated with TPE.

TPE
Enables the transfer of a large packet of data using selective call tones,
without causing other units to be called because of matching sequences. When
the transparency mode is activated by TPE, a D-digit will be inserted after
every four digits that are transmitted, which will prevent other units from
being called. The TPE instruction is normally used in combination with the
SDIAL instruction for transferring a dialing string.

TSET 'toneset'
Selects the toneset for transmission of selective call messages. The
available tonesets are: ZVEI, CCIR, EEA, PZVEI, DZVEI, PCCIR, PDZVEI, ZVEI-2,
EIA, Natel, AP-369 and Kenwood. Note that the length per tone is not defined
in the TSET Instruction, but must be set separately using the LEN
instruction.

TXD
Switches to transmit mode, in preparation for DTMF digit transmission. For
each SEND and related instruction that follows, DTMF digits will be sent.

TXF 'rf-freq'
Switches to transmit mode, using the in-line specified RF frequency. The
specified RF frequency must be within the selected RF band. For example, in
a VHF transceiver, the instruction TXF 149.0500 will cause the transceiver to
transmit on 149.0500 MHz. The transmit path selection will not change.

TXM
Switches to transmit mode, enables speech (microphone) transmission.

TXP
Switches to transmit mode, using the programmed frequency for the selected
channel. The transmit path selection (selcall, DTMF, microphone) will not
change.

TXS
Switches to transmit mode, enables selcall digit transmission. For each SEND
and related instruction that follows, selective call digits will be sent.

TXTOF
The TXTOF instruction restores the display to normal operation after using
the display for text output by the TEXT command.

WAITR
Waits until key is released. This instruction can be used to prolong DTMF
tones sent while a key is pressed in the DTMF overdialing mode.

XCARR
Aborts execution of the current encode format if an RF carrier is detected by
the receiver. XCARR can be used to create a carrier lockout condition to
prevent speech transmission and calls while the channel is occupied.

XCLOS
Aborts execution of the current encode format if the selcall mute state is
'closed' when the current encode format is started. The following example
describes a possible application. To prevent the transmission of an
immediate call while the transceiver is in a 'closed' state, encode sequence
'OPEN XCLOS' will cause the transceiver to open first and test the selcall
mute state before executing XCLOS. Execution of this sequence will be
aborted if the transceiver was previously in a closed state.

XCTCN
Aborts execution of the current encode format if an RF carrier is detected by
the receiver without SAT or with a wrong SAT tone received simultaneously.
This instruction can be used to lock-out usage of a repeater station when the
repeater is used by another user group.

XCTCW
Aborts execution of the current encode format if no carrier is detected, or
if no SAT or a wrong SAT tone is received. This instruction can be used to
allow transmission only if a valid SAT tone has already been received.

XIDLE
Aborts execution of the current encode format if the Return-to-standby mode
is set to idle. Execution proceeds when the Return-to-standby mode is set to
listen (monitor) or active.

XLIST
Aborts execution of the current encode format if the current Return-to-
standby is not set to active. This instruction can be used to prevent speech
transmission in the Return-to-standby idle or listen (monitor) mode.

XNOT (mobile only)
Aborts execution of the current encode format if the transfer function is
disabled. This instruction can be used to transmit a transfer call or pager
call when an incoming call is received, or prevent transmission of such a
call if this function is disabled by the user of the transceiver.

XOPEN
Aborts execution of the current encode format if the selcall mute state is
'open' when the current encode format is started. This instruction can be
used to prevent calls while the unit is 'open' (for example in a dispatch-
oriented system).

XPRI
Aborts execution of the current encode format if priority scanning is active
at the start of the current encode format. See XCLOS example for combining
XPRI with STOPP.

XSAT 'st-tone'
Aborts execution of the current encode format when the QT/DQT specified with
'st-tone' is received.

XSCAN
Aborts execution of the current encode format if scanning is active at the
start of the current encode format. See XCLOS example for combining XSCAN
with STOPS.

XSENS
Aborts execution of the current encode format if the transceiver is scanning
and has not temporarily stopped because of activity on a channel. Thus,
XSENS can be used to allow transmission if scanning is not active or if
scanning has temporarily stopped on a channel.

6.7.3 Status message

This option allows you to store up to 32 different 16 character messages.
These messages can be displayed on the LCD via the SELM instruction, and the
number associated with the message sent using the SENDS instruction. In
addition, if you receive a two digit code from someone, its corresponding
message can be displayed in Queue mode using the message key.

6.7.4 Queue message

This option allows you to assign a name, up to 16 characters, for up to 32
different address codes. These names can be displayed on the LCD via the
SELC instruction, and the address associated with the name called using the
SENDC instruction. In addition, if you receive an address and message from
someone, the corresponding name to that address can be displayed in Queue
mode using the message key. To switch from the address to the message (6.9)
use the Queue msg key.

6.7.5 Kenwood toneset

This feature allows you to create an original toneset.

The commands added to the TK–249/349/709/809 ICM Ver. 1.06 and onward are listed below:

Decode Format

– DISPM   Select queue message mode
– SSTO   Status store

Encode Format

– SCPH   QT phase 180 degrees
– SELM   Select status message
– SENDC   Send queue
– SENDS   Send status
– STRTS   Start scanning
– STRTP   Start priority scan
– XSAT 'st–tone' Exit when the QT/DQT specified with 'st–tone' is received
– ENC 'enc'   Execute encode format
– SELC   Select queue message
– SELMC   Select queue message and status message

Ver. 1.01 contains a revised explanation of the XSAT instruction (Encode format).

APPENDIX A: Glossary

QT: Quiet Tone (CTCSS). Sub-audible tone continuously sent.

DQT: Digital Quiet Tone. Also DPL or Digital Private Line.

DPL: Digital Private Line. Motorola equivalent for DQT.

DTMF: Dual Tone Multiple Frequency. Also called touch-tone.

LED: Light Emitting Diode.

LCD: Liquid Crystal Display.

PL: Private Line. Motorola equivalent for QT.

PTT: Push-To-Talk.

Rts: Return-to-standby.

SAT: Sub audible tone. Includes both QT and DQT, because they both use
          the sub-audible frequency range from 0 to 250 Hz.

Selcall: Selective Calling.

APPENDIX B: Accessories

Mobile:
The KENWOOD TK-759/859/752/852 mobile transceivers can be used with the
following accessories:

* Normal microphone (part number KMC-22)
* Keypad/microphone (part number KMC-23, KMC-24)
* Programming cable (part number KPG-4)

The following accessories are available:
* KPG-28D programming software for system engineers and dealers

Portable:
The KENWOOD TK-259 and TK-359 transceivers can be used with the following
accessories:

* Speaker/microphone (part number KMC-17)
* Keypad (part number KDM-7)
* Programming cable (part number KPG-8 or KPG-22)

The following accessories are available:
* KPG-32D programming software for system engineers and dealers

APPENDIX C: Selcall toneset standards

Frequencies in Hz

Tone	ZVEI	CCIR	EEA	PZVEI	DZVEI	PCCIR	PDZVEI	ZVEI2	EIA	Natel	AP-369	Kenw
0	2400	1981	1981	2400	2200	1981	2200	2400	600	1633	980	815
1	1060	1124	1124	1060	970	1124	970	1060	741	631	1190	882
2	1160	1197	1197	1160	1060	1197	1060	1160	882	697	1380	954
3	1270	1275	1275	1270	1160	1275	1160	1270	1023	770	1600	1032
4	1400	1358	1358	1400	1270	1358	1270	1400	1164	852	1800	1117
5	1530	1446	1446	1530	1400	1446	1400	1530	1305	941	2010	1209
6	1670	1540	1540	1670	1530	1540	1530	1670	1446	1040	2220	1308
7	1830	1640	1640	1830	1670	1640	1670	1830	1587	1209	2410	1415
8	2000	1747	1747	2000	1830	1747	1830	2000	1728	1336	2590	1531
9	2200	1860	1860	2200	2000	1860	2000	2200	1869	1477	2820	1657
A	2800	2400	1055	970	2600	1055	825	886	2151	1633	770	1939
B	810	930	930	810	2800	930	886	810	2433	600	740	2270
C	970	2247	2247	2800	886	2400	2600	2600	2010	1995	N/A	2098
D	886	991	991	886	810	991	2800	2800	2292	2205	N/A	2457
E	2600	2110	2110	2600	2400	2110	2400	970	459	1805	2960	1792

--Period (ms)-----------------------

| | 70 | 100 | 40 | 70 | 70 | 100 | 70 | 70 | 33 | 70 | 70 | 70 |

A = Group tone
C = Default remote close tone
E = Repeat tone
N.T. = No tone specified

APPENDIX D: QT frequencies

Frequencies in Hz

67.0	103.5	162.2
69.3	107.2	167.9
71.9	110.9	173.8
74.4	114.8	179.9
77.0	118.8	186.2
79.7	123.0	192.8
82.5	127.3	203.5
85.4	131.8	210.7
88.5	136.5	218.1
91.5	141.3	225.7
94.8	146.2	233.6
97.4	151.4	241.8
100.0	156.7	250.3

APPENDIX E: DQT codes
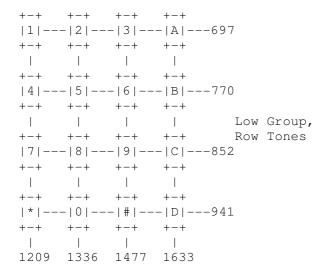
(Turn off code is 200 ms, 135 Hz)

Standard 83 codes used in the DQT scheme

Low Series	100 Series	200 Series	300 Series	400 Series	500 Series	600 Series	700 Series
023	114	205	306	411	503	606	703
025	115	223	311	412	506	612	712
026	116	226	315	413	516	624	723
031	125	243	331	423	532	627	731
032	131	244	343	431	546	631	732
043	132	245	346	432	565	632	734
047	134	251	351	445		654	743
051	143	261	364	464		662	754
054	152	263	365	465		664	
065	155	265	371	466			
071	156	271					
072	162						
073	165						
074	172						
	174						

DQT employs fixed octal digit 4 as the first digit, followed by three octal digits shown in the table above. Code words are 23-bit strings: 12 bits of octal code (9-bit address, 3-bit synchronization code), followed by 11 bits of CRC. Each bit is 7.5 ms, just over 170 ms per word.

APPENDIX F: DTMF frequencies

```
  +-+   +-+   +-+   +-+
 |1|---|2|---|3|---|A|---697
  +-+   +-+   +-+   +-+
  |     |     |     |
  +-+   +-+   +-+   +-+
 |4|---|5|---|6|---|B|---770
  +-+   +-+   +-+   +-+
  |     |     |     |       Low Group,
  +-+   +-+   +-+   +-+      Row Tones
 |7|---|8|---|9|---|C|---852
  +-+   +-+   +-+   +-+
  |     |     |     |
  +-+   +-+   +-+   +-+
 |*|---|0|---|#|---|D|---941
  +-+   +-+   +-+   +-+
  |     |     |     |
 1209  1336  1477  1633
```

High Group, Column Tones

APPENDIX G: Beep alerts

For BEEP format, BEEP 0 to 46 can be set. Values are expressed in Hz.

```
0 |1568 Hz(50ms) |

1 |622 Hz(50ms)   |Pause(50ms)    |622 Hz(50ms)   |

2 |622 Hz(50ms)   |Pause(50ms)    |784 Hz(50ms)   |

3 |784 Hz(50ms)   |Pause(50ms)    |622 Hz(50ms)   |

4 |1568 Hz(200ms)|

5 |1760 Hz(80ms) |Pause(20ms)    |1760 Hz(80ms) |

6 |622 Hz(50ms)   |Pause(50ms)    |784 Hz(50ms)   |

7 |622 Hz(50ms)   |Pause(50ms)    |622 Hz(50ms)   |

8 |831 Hz(30ms)   |Pause(30ms)    |831 Hz(30ms)   |

9 |831 Hz(50ms)   |Pause(50ms)    |831 Hz(50ms)   |Pause(50ms)    |
  |831 Hz(50ms)   |

10|622 Hz(1s)     |

11|988 Hz(1s)     |

12|622 Hz(1s)     |Pause(250ms) |622 Hz(250ms) |Pause(60ms)    |
  |622 Hz(250ms) |

13|988 Hz(1s)     |Pause(250ms) |988 Hz(250ms) |Pause(60ms)    |
  |988 Hz(250ms) |

14|622 Hz(150ms) |Pause(30ms)    |622 Hz(150ms) |

15|932 Hz(250ms) |Pause(30ms)    |932 Hz(250ms) |

16|622 Hz(100ms) |Pause(100ms)  |932 Hz(300ms) |Pause(300ms)   |
  (Repeat four times)

17|622 Hz(50ms)   |Pause(50ms)    |932 Hz(150ms) |Pause (150ms) |
  (Repeat four times)

18|831 Hz(50ms)   |1245 Hz(50ms) |1760 Hz(50ms) |  (Repeat for 38 seconds)

19|932 Hz(500ms) |Pause(500ms)  |  (Repeat)

20|622 Hz(500ms) |Pause(100ms)  |622 Hz(140ms) |Pause(100ms)   |
  |622 Hz(140ms) |Pause(500ms)  |  (Repeat)
```

```
21|932 Hz(500ms) |Pause(100ms)  |932 Hz(120ms) |Pause(100ms)  |
  |932 Hz(120ms) |Pause(500ms)  | (Repeat)

22|622 Hz(150ms) |Pause(50ms)   |622 Hz(150ms) |Pause(550ms)  | (Repeat)

23|932 Hz(250ms) |Pause(50ms)   |932 Hz(250ms) |Pause(550ms)  | (Repeat)

24|622 Hz(100ms) |Pause(100ms)  |932 Hz(300ms) |Pause(800ms)  | (Repeat)

25|622 Hz(50ms)  |Pause(50ms)   |932 Hz(150ms) |Pause(700ms)  | (Repeat)

26|831 Hz(50ms)  |1245 Hz(50ms) |1760 Hz(50ms) |831 Hz(50ms)  |
  |1245 Hz(50ms) |1760 Hz(50ms) |831 Hz(50ms)  |Pause(2.5s)   | (Repeat)

27|1568 Hz(50ms) |

28|622 Hz(50ms)  |Pause(50ms)   |622 Hz(50ms)  |

29|622 Hz(50ms)  |Pause(50ms)   |784 Hz(50ms)  |

30|784 Hz(50ms)  |Pause(50ms)   |622 Hz(50ms)  |

31|1568 Hz(200ms)|

32|494 Hz(60ms)  |587 Hz(60ms)  |      ...     |494 Hz(60ms)  |
  |<---------------------------1200ms---------------------

  |587 Hz(60ms)  |Pause(1270ms) | (Repeat)   Call alert tone
  ------------->|

33|1396 Hz(200ms)|Pause(200ms)  | (1 beep)   Power on tone

34|740 Hz        | (Continuous beep)          TOT tone

35|1046 Hz(50ms) |Pause(50ms)   | (3 beeps)  TOT pre-alert tone

36|1396 Hz(50ms) |Pause(50ms)   | (1 beep)   Key function ON beep

37|1396 Hz(50ms) |Pause(50ms)   | (2 beeps)  Key function OFF beep

38|830 Hz(100ms) |Pause(100ms)  | (1 beep)   Operation error beep

39|1396 Hz(50ms) |Pause(50ms)   | (1 beep)   Self-programming
                                              confirmation beep

40|880 Hz(50ms)  |Pause(50ms)   | (1 beep)   PA vol up tone

41|1396 Hz(50ms) |Pause(50ms)   | (3 beeps)  PA vol max tone

42|784 Hz(50ms)  |Pause(50ms)   | (1 beep)   PA vol down tone

43|659 Hz(50ms)  |Pause(50ms)   | (3 beeps)  PA vol min tone
```

```
44|1700 Hz(50ms) |1800 Hz(50 ms) |1900 Hz(50ms) |2000 Hz(50ms) |
  (Continuous beeps)

45|440 Hz(50ms)  |Pause(50ms)    |440 Hz(800ms) |Pause(800ms)  |  (1 beep)

46|1200 Hz(40ms) |1470 Hz(40ms) |1200 Hz(40ms) |1470 Hz(40ms) |
  |1200 Hz(40ms) |1470 Hz(40ms) |1200 Hz(40ms) |1470 Hz(40ms) |
  |1200 Hz(40ms) |1470 Hz(40ms) |1200 Hz(40ms) |1470 Hz(40ms) |
  |1200 Hz(40ms) |1470 Hz(40ms) |Pause(200ms)  |1200 Hz(40ms) |
  |1470 Hz(40ms) |1200 Hz(40ms) |1470 Hz(40ms) |1200 Hz(40ms) |
  |1470 Hz(40ms) |1200 Hz(40ms) |1470 Hz(40ms) |1200 Hz(40ms) |
  |1470 Hz(40ms) |1200 Hz(40ms) |1470 Hz(40ms) |1200 Hz(40ms) |
  |1470 Hz(40ms) |Pause(2s)     |  (Repeat)
```