

# RT-5D DMR Transceiver

## Data Structure Reference

*Complete byte-level documentation of all data blocks exchanged during programming*

Derived from CPS source code (JJCC-888DMR\_CPS) – February 2026

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### Document Conventions

This document describes every byte of every data block sent between the CPS host software and the RT-5D radio over its programming serial link. Blocks are listed in the order they appear in the protocol sequence.

Convention	Meaning
0xFF	Byte value 255 decimal. Used throughout as a padding/fill byte and as the empty-entry sentinel in list structures.
0x00	Byte value 0 decimal.
little-endian (LE)	Multi-byte integers stored least-significant byte first.
big-endian (BE)	Multi-byte integers stored most-significant byte first.
nibble (low)	Bits 3:0 of a byte. Bit-mask: value & 0x0F.
nibble (high)	Bits 7:4 of a byte. Bit-mask: (value >> 4) & 0x0F.
GB2312	Chinese national standard character encoding. ASCII-compatible for codepoints ≤ 0x7F; Chinese characters use 2 bytes ≥ 0x80.
Default value	The value the CPS pre-populates when no radio data has been loaded.

All sizes are in bytes. All offsets are relative to the start of the block payload (i.e., byte 0 of the payload data following the 6-byte frame header).

## 1. Handshake Block

Property	Value
Command (Read/Write)	0x02 (CmdHandshake)
Packet count	1
Payload size	15 bytes
Direction	Host → Radio (request), Radio → Host (response same cmd)

The handshake payload is a fixed 15-byte ASCII string that identifies the CPS to the radio and places the radio into programming mode. The radio echoes back a valid framed response using the same command byte. The CPS does not validate the content of the radio's reply body, only that a correctly-framed packet is received.

Offset (bytes)	Size	Field Name	Encoded Values / Notes
0 - 14	15	Handshake string	ASCII: PROGRAMJC8810DU (fixed, hardcoded)

Hex representation of the handshake payload:

50 52 4F 47 52 41 4D 4A 43 38 38 31 30 44 55

## 2. Password Block

Property	Value
Command	0x05 (CmdCheckPwd)
Packet count	1
Payload size	6 bytes
Direction	Host → Radio

Sends the terminal unlock password to the radio. The CPS always sends 6 bytes of 0xFF, representing the default blank/no-password state. The radio validates this against its stored password. A NAK (0xEE) response command byte indicates authentication failure.

Offset (bytes)	Size	Field Name	Encoded Values / Notes
0 - 5	6	Password bytes	Fixed: FF FF FF FF FF FF (default blank password)

## 3. Version Block

Property	Value
Command	0x46 (CmdGetVersion)
Packet count	1
Payload size	128 bytes
Direction	Host → Radio (request with 128 zero bytes); Radio → Host (response with version data)

The host sends 128 zero bytes as a placeholder read request. The radio responds with 128 bytes of version and identity information. The CPS acknowledges receipt but does not parse or act on the content of the version response – it serves only as a handshake confirmation that the radio model is compatible.

Offset (bytes)	Size	Field Name	Encoded Values / Notes
0 - 127	128	Version data	Content defined by radio firmware. CPS sends all 0x00 as request; radio responds with version string and firmware build information.

## 4. DTMF Block

Property	Value
Read command	0x16 (CmdReadDtmf)
Write command	0x36 (CmdWriteDtmf)
Packet count	1
Payload size	272 bytes total
Sequence number	0 (single packet, always 0)

The DTMF block carries the radio's DTMF (Dual-Tone Multi-Frequency) configuration in two contiguous sub-regions: a 32-byte global settings area followed by a 240-byte code group list.

### 4.1 DTMF Global Settings (bytes 0–31)

Offset (bytes)	Size	Field Name	Encoded Values / Notes
0 – 4	5	DtmfCurId	Current DTMF ID digits. Each byte encodes one digit as an index into the alphabet "0123456789ABCD*#" (values 0–15). Unused digit positions are 0xFF. Default: "12345" → [01 02 03 04 05].
5	1	(reserved)	0xFF padding.
6	1	DtmfPttId	Low nibble only (& 0x0F), modulo 4. See value table below.
7	1	DtmfDuration	Low nibble only, modulo 5. See value table below.
8	1	DtmfInterval	Low nibble only, modulo 5. See value table below.
9 – 31	23	(reserved)	0xFF padding.

#### DtmfPttId values (byte 6, low nibble)

Value (decimal)	Meaning
0	OFF – no PTT ID transmitted
1	BOT (Beginning of Transmission) – send ID when PTT pressed
2	EOT (End of Transmission) – send ID when PTT released
3	BOTH – send ID at start and end of transmission

#### DtmfDuration values (byte 7, low nibble)

Value (decimal)	Meaning
0	50 ms
1	100 ms (default)
2	150 ms
3	200 ms
4	250 ms

#### DtmfInterval values (byte 8, low nibble)

Value (decimal)	Meaning
0	50 ms
1	100 ms (default)
2	150 ms
3	200 ms
4	250 ms

## 4.2 DTMF Code Group List (bytes 32–271)

15 code groups, each occupying 16 bytes, packed contiguously. Group N starts at offset  $32 + (N \times 16)$ . An entry whose first byte is 0xFF is treated as empty.

Offset within entry	Size	Field	Encoding
0 - 5	6	DtmfCode digits	Each byte = digit index 0-15 in alphabet "0123456789ABCD*#". Fewer than 6 digits: remaining bytes are 0xFF. First byte 0xFF → entry is empty.
6 - 15	10	(reserved padding)	0xFF

Character alphabet: index 0='0', 1='1', ..., 9='9', 10='A', 11='B', 12='C', 13='D', 14='\*', 15='#'.

## 5. Encryption Key Block

Property	Value
Read command	0x15 (CmdReadEncKey)
Write command	0x35 (CmdWriteEncKey)
Packet count	1
Payload size	264 bytes
Capacity	8 key entries

Carries up to 8 encryption key definitions. Each entry is 33 bytes. Entry N starts at offset  $N \times 33$ . An entry whose bytes 0 and 1 are both 0xFF is treated as empty/unused.

### 5.1 Key Entry Structure (33 bytes per entry)

Offset (bytes)	Size	Field Name	Encoded Values / Notes
0	1	EncAlgo	Low nibble (& 0x0F), modulo 3. Encryption algorithm selector. See table below.
1 - 32	32	EncKey digits	Each byte = hex digit index 0-15 in alphabet "0123456789ABCDEF". Bytes 0xFF indicate unused digit positions. Number of significant bytes depends on algorithm.

#### EncAlgo values (byte 0, low nibble)

Value	Algorithm	Key Length (bytes)	Key Length (hex chars)	Notes
0	ARC4 (RC4 compatible)	5	10	Proprietary basic scrambling
1	AES-128	16	32	Standard AES 128-bit
2	AES-256	32	64	Standard AES 256-bit

When writing, the CPS pads the key string with '0' characters on the right to reach the required length for the selected algorithm, then truncates to exactly that length. The bytes beyond the required length in the 32-byte field are set to 0xFF.

## 6. Address Book Block

Property	Value
Read command	0x13 (CmdReadAddrBook)
Write command	0x33 (CmdWriteAddrBook)
Packet count	80
Payload size per packet	800 bytes
Total payload	64,000 bytes
Contacts per packet	50
Maximum total contacts	4,000
Sequence number	0-79 (increments per packet)

The address book (digital contact list / DMR ID book) is split into 80 consecutive packets. Packet N carries the 50 contacts at positions Nx50 through Nx50+49 in the full contact list. Each contact record is 16 bytes. A contact whose byte 0, byte 1, or byte 5 is 0xFF is ignored. The CPS also ignores All-Call entries during import.

### 6.1 Contact Record Structure (16 bytes)

Offset (bytes)	Size	Field Name	Encoded Values / Notes
0	1	CallType	Low nibble (& 0x0F), modulo 3. Call type selector. See table below.
1	1	(zero byte)	Must be 0x00 for a valid entry. If 0xFF, the record is treated as empty.
2	1	CallId MSB	Most significant byte of the 24-bit DMR ID (big-endian). Byte 1 of the ID integer.
3	1	CallId mid	Middle byte of the 24-bit DMR ID.
4	1	CallId LSB	Least significant byte of the 24-bit DMR ID.
5 - 14	10	ContactName	GB2312 encoded string. Null (0x00) or 0xFF terminated. If byte 5 is 0xFF, the entry is treated as empty.
15	1	(padding)	0xFF

#### CallType values (byte 0, low nibble)

Value (decimal)	Meaning
0	Group Call
1	Private Call (Individual)
2	All Call

#### CallId encoding

The DMR ID is a 24-bit unsigned integer stored in bytes 1-4 of the record:

- Byte 1 = always 0x00 (the MSByte of the 32-bit representation is zero, confirming 24-bit ID range)
- Byte 2 = (CallId >> 16) & 0xFF
- Byte 3 = (CallId >> 8) & 0xFF
- Byte 4 = CallId & 0xFF

Valid range: 1 to 16,777,215 (0x0000001 to 0xFFFFFFF). The CPS enforces this range on both read and write.

**Note:** The default address book contains one entry: *CallType=2 (All Call)*, *CallId=16,777,215*, *ContactName="Call.All"*. This entry is protected — it is not exported to the radio and is re-added automatically if deleted.

## 7. Receive Group List Block

Property	Value
Read command	0x14 (CmdReadRxGroup)
Write command	0x34 (CmdWriteRxGroup)
Packet count	4
Payload size per packet	1,024 bytes
Total payload	4,096 bytes
Groups per packet	8
Maximum total groups	32
Maximum members per group	32
Sequence number	0-3 (increments per packet)

The Rx Group List defines sets of DMR contacts (private call IDs) that a channel can listen to selectively. Each packet carries 8 group entries. Group N in a packet starts at byte ( $N \times 128$ ) within the packet payload. An entry whose byte 96 (the first byte of the name field) is 0xFF is treated as empty.

### 7.1 Group Entry Structure (128 bytes per entry)

Offset (bytes)	Size	Field Name	Encoded Values / Notes
0 - 95	96	Member ID list	Up to 32 member DMR IDs, each 3 bytes (24-bit, big-endian). Unused member slots are three 0x00 bytes. First slot with 0x00 0x00 marks end of list.
96 - 107	12	RxGroupName	GB2312 encoded string. Null (0x00) or 0xFF terminated. First byte 0xFF → entry is empty.
108 - 127	20	(padding)	0xFF

### 7.2 Member ID Encoding (3 bytes per member)

Each member occupies bytes [i×3], [i×3+1], [i×3+2] within the 96-byte member block:

- Byte 0 of member = (CallId >> 16) & 0xFF
- Byte 1 of member = (CallId >> 8) & 0xFF
- Byte 2 of member = CallId & 0xFF

During reading, each member ID is looked up in the address book to resolve the contact name. On write, member IDs are taken from the contact's CallId. Members with all-zero ID bytes mark the end of the member list.

## 8. Channel Mode Block

Property	Value
Read command	0x10 (CmdReadChMode)
Write command	0x30 (CmdWriteChMode)
Packet count	64
Payload size per packet	1,024 bytes
Total payload	65,536 bytes
Channels per packet	16
Bytes per channel record	64
Maximum areas	16
Maximum channels per area	64
Maximum total channel slots	1,024 (16 areas × 64 channels)
Sequence number	0-63 (increments per packet)

Channel data is the largest single data region. Channels are numbered linearly from 0 to 1023 across all areas. The area index and in-area channel index are derived as: area = channel\_index / 64, in\_area\_channel = channel\_index % 64. Packet N carries channels Nx16 through Nx16+15.

A channel record is treated as empty if the first 4 bytes (RxFreq field) are all 0xFF or all 0x00.

### 8.1 Channel Record Structure (64 bytes)

Offset (bytes)	Size	Field Name	Encoded Values / Notes
0 - 3	4	RxFreq	32-bit little-endian integer, frequency in units of 10 Hz. e.g., 145,500,000 Hz (145.5 MHz) = 14,550,000 decimal = 0x00DE1B90, stored LE as 90 1B DE 00.
4 - 7	4	TxFreq	Same format as RxFreq. Set equal to RxFreq for simplex operation.
8 - 9	2	RxSubaudio	CTCSS/DCS sub-audio tone for receive. See Sub-Audio encoding (Section 8.2).
10 - 11	2	TxSubaudio	CTCSS/DCS sub-audio tone for transmit. Same encoding as RxSubaudio.
12	1	SignalingCode	Low nibble, modulo maxDtmfCodeGroupCount (15). Index into DTMF code group list (0 = none/off).
13	1	ChPttId	Low nibble, modulo 4. Per-channel PTT ID mode. Values: 0=OFF, 1=BOT, 2=EOT, 3=BOTH.
14	1	ChannelType flag A	Low nibble, modulo 2. 1=Analog (FM), 0=Digital (DMR). Combined with byte 15.
15	1	ChannelType flag B	Low nibble, modulo 2. When byte 14=0: 0=DMR Tier I (simplex), 1=DMR Tier II (repeater). When byte 14=1: 0=Wideband, 1=Narrow band.
16	1	TxPower	Low nibble, modulo 3. Transmit power level. Values: 0=Low, 1=Middle, 2=High.
17	1	Scramble	Low nibble, modulo 9. Analog scrambler type/code (0=Off, 1-8=scrambler codes).
18	1	Encryption	Low nibble, modulo 4. Digital encryption mode. Values: 0=None, 1=Basic, 2=Enhanced, 3=AES.

Offset (bytes)	Size	Field Name	Encoded Values / Notes
19	1	BusyLockout	Low nibble, modulo 2. 0=Off (transmit even if channel busy), 1=On (lock TX if busy).
20	1	ScanAdd	Low nibble, modulo 2. 0>No (exclude from scan list), 1=Yes (include in scan list).
21	1	TimeSlot	Low nibble, modulo 2. DMR time slot. 0=TS1, 1=TS2. Ignored on analog channels.
22	1	ColorCode	Low nibble, modulo 16. DMR color code 0-15. Ignored on analog channels.
23	1	RxGroup	Byte value, modulo (maxRxGroupCount+1) = modulo 33. 0=None, 1-32=Rx group index.
24	1	(reserved)	0xFF
25	1	EncKey	Low nibble, modulo maxEncKeyCount (8). Index 0-7 into encryption key list (0=first key).
26	1	DmrMode	Low nibble, modulo 2. 0=Direct/Simplex (DMR Tier I), 1=Repeater (DMR Tier II). Affects how the radio handles call routing.
27	1	LearnFhss	Low nibble, modulo 2. Frequency Hopping Spread Spectrum auto-learn. 0=Off, 1=On.
28 - 31	4	FhssCode	FHSS hop sequence code. See FHSS encoding (Section 8.3). 0xFF in byte 31 indicates no FHSS code is set.
32 - 43	12	ChannelName	GB2312 encoded channel name string. Null (0x00) or 0xFF terminated.
44 - 45	2	Contact	Little-endian 16-bit index into address book (0=none/not set, 1-based index).
46 - 63	18	(reserved padding)	0xFF

## 8.2 Sub-Audio Encoding (2 bytes)

The 2-byte sub-audio field encodes three possible states: OFF, a CTCSS tone, or a DCS code.

State	Byte 0	Byte 1	Decoded Value
OFF	0x00	0x00	No sub-audio / carrier squelch only
DCS code	DCS index + 1 (1-210)	0x00	DCS table entry at index (byte0 - 1). 105 normal (N) codes followed by 105 inverted (I) codes. e.g., 0x01 = D023N, 0x69 = D754N, 0x6A = D023I
CTCSS tone	Low byte of (freq × 10)	High byte of (freq × 10)	CTCSS frequency = (byte1 << 8   byte0) / 10 Hz. e.g., 88.5 Hz: 885 = 0x0375 → byte0=0x75, byte1=0x03

## Complete CTCSS Tone Table (50 standard tones)

Standard tones supported: 67.0, 69.3, 71.9, 74.4, 77.0, 79.7, 82.5, 85.4, 88.5, 91.5, 94.8, 97.4, 100.0, 103.5, 107.2, 110.9, 114.8, 118.8, 123.0, 127.3, 131.8, 136.5, 141.3, 146.2, 151.4, 156.7, 159.8, 162.2, 165.5, 167.9, 171.3, 173.8, 177.3, 179.9, 183.5, 186.2, 189.9, 192.8, 196.6, 199.5, 203.5, 206.5, 210.7, 218.1, 225.7, 229.1, 233.6, 241.8, 250.3, 254.1 Hz. Non-standard tones in range 60.0–260.0 Hz are also accepted.

## 8.3 FHSS Code Encoding (bytes 28–31)

The FHSS code is a 6-character uppercase hexadecimal string representing values 0x000000 to 0x7FFFFF. It is packed into 3 bytes (bytes 28-30) in reversed nibble order, with byte 31 used as a validity flag:

Offset (bytes)	Size	Field Name	Encoded Values / Notes
28	1	FHSS code LSB byte	Packed: high nibble = hex digit 4 (0-indexed from MSB), low nibble = hex digit 5
29	1	FHSS code mid byte	Packed: high nibble = hex digit 2, low nibble = hex digit 3
30	1	FHSS code MSB byte	Packed: high nibble = hex digit 0, low nibble = hex digit 1
31	1	FHSS validity flag	0x00 = valid FHSS code present. 0xFF = no FHSS code (entry unused).

**Note:** Example: FHSS code "1A2B3C" → digit0=1,1=A,2=2,3=B,4=3,5=C. byte30=(1<<4|A)=0x1A, byte29=(2<<4|B)=0x2B, byte28=(3<<4|C)=0x3C, byte31=0x00.

## 8.4 ChannelType Combined Decoding

The ChannelType field visible in the CPS is derived from bytes 14 and 15 together using the formula: ChannelType = (byte14 & 0x0F) % 2 + (byte15 & 0x0F) % 2.

Byte 14 (nibble)	Byte 15 (nibble)	ChannelType value	Meaning
0	0	0	Analog FM
1	0	1	Digital DMR Tier I (simplex)
1	1	2	Digital DMR Tier II (repeater)

## 9. VFO Mode Block

Property	Value
Read command	0x11 (CmdReadVfoMode)
Write command	0x31 (CmdWriteVfoMode)
Packet count	1
Payload size	128 bytes
VFO banks	2 (Bank A at bytes 0-63; Bank B at bytes 64-127)
Default RxFreq Bank A	136.12500 MHz
Default RxFreq Bank B	400.12500 MHz

The VFO block carries two VFO bank definitions, each 64 bytes. The layout is nearly identical to a channel record with three differences: the StepFreq field replaces LearnFhss (byte 27), the Contact field is at bytes 32-33 rather than 44-45, and there is no ChannelName, ScanAdd, or ChPttId field.

If a frequency read from the radio is all 0x00 or all 0xFF, the CPS substitutes the bank's default frequency automatically.

### 9.1 VFO Bank Structure (64 bytes)

Offset (bytes)	Size	Field Name	Encoded Values / Notes
0 - 3	4	RxFreq	32-bit LE integer, 10 Hz units. Same encoding as channel. Default A=136.125 MHz, B=400.125 MHz.
4 - 7	4	TxFreq	Same format as RxFreq.
8 - 9	2	RxSubaudio	CTCSS/DCS sub-audio. Same encoding as channel (Section 8.2). Default: OFF.
10 - 11	2	TxSubaudio	Same encoding as RxSubaudio. Default: OFF.
12	1	SignalingCode	Low nibble, modulo 15. DTMF code group index. 0=none.
13	1	(unused)	0xFF. Note: ChPttId is not stored in VFO mode.
14	1	ChannelType flag A	Low nibble. Same as channel byte 14.
15	1	ChannelType flag B	Low nibble. Same as channel byte 15.
16	1	TxPower	Low nibble, modulo 3. 0=Low, 1=Medium, 2=High.
17	1	Scramble	Low nibble, modulo 9. 0=Off, 1-8=scrambler codes.
18	1	Encryption	Low nibble, modulo 4. 0=None, 1=Basic, 2=Enhanced, 3=AES.
19	1	BusyLockout	Low nibble, modulo 2. 0=Off, 1=On.
20	1	(unused)	0xFF. Note: ScanAdd is not applicable to VFO.
21	1	TimeSlot	Low nibble, modulo 2. 0=TS1, 1=TS2.
22	1	ColorCode	Low nibble, modulo 16. DMR color code 0-15.
23	1	RxGroup	Byte value, modulo 33. 0=None, 1-32=Rx group index.
24	1	(unused)	0xFF
25	1	EncKey	Low nibble, modulo 8. Encryption key index.
26	1	DmrMode	Low nibble, modulo 2. 0=Simplex, 1=Repeater.
27	1	StepFreq	Low nibble, modulo 8. Tuning step size. See value table below.
28 - 31	4	(unused)	0xFF. FHSS is not applicable to VFO mode.
32 - 33	2	Contact	Little-endian 16-bit address book index. 0=none.

Offset (bytes)	Size	Field Name	Encoded Values / Notes
34 - 63	30	(reserved padding)	0xFF

### StepFreq values (byte 27, low nibble)

Value (decimal)	Meaning
0	2.5 kHz
1	5.0 kHz
2	6.25 kHz
3	10.0 kHz
4	12.5 kHz
5	20.0 kHz
6	25.0 kHz
7	50.0 kHz

## 10. Optional Functions Block

Property	Value
Read command	0x12 (CmdReadOptionalFun)
Write command	0x32 (CmdWriteOptionalFun)
Packet count	1
Payload size	64 bytes (two 32-byte sub-regions)

This block contains all global radio settings and programmable button assignments. It is split into two 32-byte halves. The first half covers operational parameters; the second covers timing, key assignments, and digital-mode settings.

### 10.1 Optional Functions Part 1 (bytes 0–31)

Offset (bytes)	Size	Field Name	Encoded Values / Notes
0	1	AnalogSql	Low nibble, modulo 10. Analog squelch level. 0=OFF, 1-9=Level 1-9. Default: 3.
1	1	PowerSave	Low nibble, modulo 5. Battery saver duty cycle. 0=OFF, 1=1:1, 2=1:2, 3=1:3, 4=1:4. Default: 1 (1:1).
2	1	Vox	Low nibble, modulo 10. VOX sensitivity. 0=OFF, 1-9=Level 1-9. Default: 0 (OFF).
3	1	AutoBacklight	Low nibble, modulo 9. Backlight auto-off timer. 0=Bright (always on), 1=5s, 2=10s, 3=15s, 4=20s, 5=30s, 6=1min, 7=2min, 8=3min. Default: 5 (30s).
4	1	Tdr	Low nibble, modulo 2. Dual Watch (TDR). 0=OFF, 1=ON. Default: 0.
5	1	Tot	Low nibble, modulo 6. TX Time-Out Timer. 0=OFF, 1=30s, 2=60s, 3=120s, 4=240s, 5=480s. Default: 0.
6	1	Beep	Low nibble, modulo 2. Keypad beep. 0=OFF, 1=ON. Default: 1.
7	1	Voice	Low nibble, modulo 2. Voice prompt. 0=OFF, 1=ON. Default: 1.
8	1	Language	Low nibble, modulo 2. UI language. 0=English, 1=Chinese. Default: 1 (English in source).
9	1	SideTone	Low nibble, modulo 4. Side tone mode. 0=OFF, 1=DT-ST (DTMF side tone), 2=ANI-ST (ANI side tone), 3=DT+ANI. Default: 0.
10	1	ScanMode	Low nibble, modulo 3. Scan resume mode. 0=TO (time-operated), 1=CO (carrier-operated), 2=SE (search). Default: 1.
11	1	PttId	Low nibble, modulo 4. Global PTT ID. 0=OFF, 1=BOT, 2=EOT, 3=BOTH. Default: 0.
12	1	IdDelayTime	Low nibble, modulo 7. PTT ID send delay. 0=0ms, 1=100ms, 2=200ms, 3=400ms, 4=600ms, 5=800ms, 6=1000ms. Default: 4 (600ms).
13	1	DisplayModeA	Low nibble, modulo 3. Band A display. 0=Name, 1=Freq, 2=CH (channel number). Default: 0.
14	1	DisplayModeB	Low nibble, modulo 3. Band B display. 0=Name, 1=Freq, 2=CH. Default: 0.
15	1	(reserved)	0xFF
16	1	AutoLock	Low nibble, modulo 4. Auto keyboard lock timer. 0=OFF, 1=5s, 2=10s, 3=15s. Default: 0.

Offset (bytes)	Size	Field Name	Encoded Values / Notes
17	1	SosMode	Low nibble, modulo 3. SOS/emergency mode. 0=On Site (local alarm only), 1=Send Sound (TX alarm tone), 2=Send Code (TX DTMF code). Default: 0.
18	1	AlarmSound	Low nibble, modulo 2. Alarm sound enable. 0=OFF, 1=ON. Default: 1.
19	1	TdrTx	Low nibble, modulo 3. Dual Watch TX priority band. 0=OFF, 1=Band-A, 2=Band-B. Default: 0.
20	1	TailClear	Low nibble, modulo 2. Analog tail tone clear (reverse burst). 0=OFF, 1=ON. Default: 1.
21	1	RptClearTail	Low nibble, modulo 11. Repeater tail-clear tone duration in ms. 0=0ms, 1=100ms, ..., 10=1000ms. Default: 0.
22	1	RptDetectTail	Low nibble, modulo 11. Repeater tail-detect threshold. Same ms scale as byte 21. Default: 0.
23	1	TxOverSound	Low nibble, modulo 2. TX timeout warning sound. 0=OFF, 1=ON. Default: 0.
24	1	CurWorkMode	Low nibble, modulo 2. Active work band. 0=Band-A, 1=Band-B. Default: 0.
25	1	FmRadio	Low nibble, modulo 2. FM broadcast radio enable. 0=ON (allowed), 1=OFF (disabled). Default: 0.
26	1	WorkModeA + WorkModeB	High nibble = WorkModeB, Low nibble = WorkModeA. Each nibble: 0=VFO (frequency mode), 1=Channel mode. Default: both 0.
27	1	KeyLock	Low nibble, modulo 2. Keyboard lock state. 0=OFF (unlocked), 1=ON (locked). Default: 0.
28	1	BootScreen	Low nibble, modulo 2. Boot screen type. 0=Logo (preset graphic), 1=Voltage (show battery voltage). Default: 0.
29	1	(reserved)	0xFF
30	1	RTone	Low nibble, modulo 4. Roger beep tone frequency. 0=1000Hz, 1=1450Hz, 2=1750Hz, 3=2100Hz. Default: 2 (1750Hz).
31	1	TxStartSound	Low nibble, modulo 2. Sound when TX begins. 0=OFF, 1=ON. Default: 0.

## 10.2 Optional Functions Part 2 (bytes 32–63)

Offset (bytes)	Size	Field Name	Encoded Values / Notes
32	1	VoxDelayTime	Low nibble, modulo 16. VOX release delay time. 0=0.5s, 1=0.6s, 2=0.7s, 3=0.8s, 4=0.9s, 5=1.0s, 6=1.1s, 7=1.2s, 8=1.3s, 9=1.4s, 10=1.5s, 11=1.6s, 12=1.7s, 13=1.8s, 14=1.9s, 15=2.0s. Default: 5 (1.0s).
33	1	MenuAutoQuit	Low nibble, modulo 11. Menu auto-exit timer. 0=5s, 1=10s, 2=15s, 3=20s, 4=25s, 5=30s, 6=35s, 7=40s, 8=45s, 9=50s, 10=60s. Default: 1 (10s).
34	1	DigitalSql	Low nibble, modulo 10. Digital (DMR) squelch level. 0=OFF, 1-9=Level 1-9. Default: 3.
35 - 38	4	(reserved)	0xFF
39	1	SteFreq	Low nibble, modulo 2. Sub-Tone Elimination frequency. 0=55 Hz, 1=62.5 Hz. Default: 0.

Offset (bytes)	Size	Field Name	Encoded Values / Notes
40	1	WeatherCh	Low nibble, modulo 10. NOAA/Weather channel preset. 0-9 = channels 1-10. Default: 0.
41 - 42	2	(reserved)	0xFF
43	1	TopKey1S	Low nibble, modulo 7. Top button short-press function. 0=Radio, 1=Moni, 2=Scan, 3=Search, 4=SOS, 5=Noaa, 6=ScanQT. Default: 0.
44	1	SideKey2S	Low nibble, modulo 8. Side key 2 short-press function. 0=Radio, 1=Moni, 2=Scan, 3=Search, 4=SOS, 5=Noaa, 6=ScanQT, 7=PTTB. Default: 1 (Moni).
45	1	SideKey2L	Low nibble, modulo 7. Side key 2 long-press function. Same 7 values as TopKey1S. Default: 2 (Scan).
46	1	SideKey3S	Low nibble, modulo 7. Side key 3 short-press function. Same 7 values as TopKey1S. Default: 3 (Search).
47	1	SideKey3L	Low nibble, modulo 7. Side key 3 long-press function. Same 7 values as TopKey1S. Default: 4 (SOS).
48 - 49	2	(reserved)	0xFF
50	1	KeepCallTime	Bits 4:0 (& 0x1F), modulo 20. Hang-time after call ends before scanner resumes. 0=1s, 1=2s, ..., 19=20s. Default: 4 (5s).
51	1	(reserved)	0xFF
52	1	TdrRecoveryTime	Low nibble, modulo 11. Dual Watch recovery time. 0=0.5s, 1=1s, 2=2s, 3=3s, 4=4s, 5=5s, 6=6s, 7=7s, 8=8s, 9=9s, 10=10s. Default: 3 (3s).
53 - 63	11	(reserved)	0xFF

## Programmable Key Function Codes

Code	Short label	Function
0	Radio	FM broadcast radio toggle
1	Moni	Monitor / squelch open
2	Scan	Channel scan start/stop
3	Search	Frequency search/scan
4	SOS	SOS/emergency alert
5	Noaa	NOAA weather channel
6	ScanQT	Scan sub-tone (CTCSS/DCS scan)
7	PTTB	PTT for Band B (Side key 2 short only)

## 11. Basic Info Block

Property	Value
Read command	0x19 (CmdReadBasicInfo)
Write command	0x39 (CmdWriteBasicInfo)
Packet count	1
Payload size	64 bytes
Write condition	Only sent if WriteModelNameAndId flag is true in CPS

The basic info block stores the radio's model identity. Only two fields within the 64-byte payload are actively used. The write of this block is conditional: the CPS only transmits it if the user has explicitly enabled the WriteModelNameAndId option, making it suitable for production-line model stamping without affecting normal programming workflows.

### 11.1 Basic Info Payload (64 bytes)

Offset (bytes)	Size	Field Name	Encoded Values / Notes
0 - 7	8	(reserved prefix)	0xFF
8 - 19	12	ModelName	GB2312 encoded model name string. Null (0x00) or 0xFF terminated. Maximum 12 bytes. Default: "DMR".
20 - 27	8	ModelId	ASCII decimal string, zero-padded to exactly 8 characters. e.g., ModelId=1 → "00000001" → bytes: 30 30 30 30 30 30 30 31. Range: 1-16,776,415.
28 - 63	36	(reserved suffix)	0xFF

**Note:** ModelId is stored as ASCII text, not as a binary integer. When reading, the CPS parses the 8 ASCII bytes as a decimal number using int.TryParse. If SelfIncrementModelId is enabled in the CPS, the ModelId is automatically incremented after each successful write, supporting sequential device serialisation.

## 12. End Session Block

Property	Value
Command	0x01 (CmdOver)
Packet count	1
Payload size	2 bytes
Sequence number	0 (always)

Signals the end of the programming session. After receiving this packet and sending a valid response, the radio exits programming mode and returns to normal operation. Failure to send this command (e.g., due to a CPS crash or forced disconnect) will leave the radio in programming mode until it times out internally or is power-cycled.

Offset (bytes)	Size	Field Name	Encoded Values / Notes
0 - 1	2	End marker	Two bytes: 00 00

## Appendix A: Cross-Reference Table

This table shows how each data field in the CPS is stored in memory versus how it is encoded on the wire.

Field	CPS Internal Type	Wire Encoding	Block
Frequency	string (MHz, e.g. "145.5000")	32-bit LE int, units of 10 Hz	Channel, VFO
CTCSS tone	string (Hz, e.g. "88.5")	16-bit LE int = tone × 10	Channel, VFO
DCS code	string (e.g. "D023N")	byte = table index + 1, then 0x00	Channel, VFO
Channel name	string (GB2312)	GB2312 bytes, 0xFF padded, 12 bytes	Channel
Contact name	string (GB2312)	GB2312 bytes, 0xFF padded, 10 bytes	Address Book
Group name	string (GB2312)	GB2312 bytes, 0xFF padded, 12 bytes	Rx Group
DMR ID (CallId)	int (1 - 16,777,215)	4 bytes: 0x00 + 3-byte BE integer	Address Book
DMR ID (member)	int	3-byte BE integer only	Rx Group
Enc key	string (hex digits)	Each char = nibble index 0-15 in hex alpha	Enc Key
DTMF code	string (DTMF digits)	Each char = nibble index 0-15 in DTMF alpha	DTMF
DTMF ID	string (DTMF digits)	Each char = nibble index 0-15, 5 bytes max	DTMF
FHSS code	string (6 hex chars)	3 bytes packed BCD reversed, byte31=0x00	Channel
Model name	string (ASCII/GB2312)	GB2312 bytes, 0xFF padded, 12 bytes	Basic Info
Model ID	int	8-byte ASCII decimal string, zero-padded	Basic Info
Enum settings	int (0-based index)	Single byte, low nibble used, range-clamped	Optional Fun
Contact index	int (0=none)	16-bit LE (Channel: bytes 44-45; VFO: bytes 32-33)	Channel, VFO
Rx Group index	int (0=none, 1-32=group)	Single byte value	Channel, VFO

## Appendix B: Packet Size Summary

Block	Cmd (R/W)	Pkts	Payload bytes/pkt	Total payload	Frame bytes/pkt	Total on wire
Handshake	0x02	1	15	15	23	23
Password	0x05	1	6	6	14	14
Version	0x46	1	128	128	136	136
DTMF	0x16/0x36	1	272	272	280	280
Enc Keys	0x15/0x35	1	264	264	272	272
Address Book	0x13/0x33	80	800	64,000	808	64,640

Block	Cmd (R/W)	Pkts	Payload bytes/pkt	Total payload	Frame bytes/pkt	Total on wire
Rx Groups	0x14/0x34	4	1,024	4,096	1,032	4,128
Channels	0x10/0x30	64	1,024	65,536	1,032	66,048
VFO Mode	0x11/0x31	1	128	128	136	136
Optional Fun	0x12/0x32	1	64	64	72	72
Basic Info	0x19/0x39	1	64	64	72	72
End Session	0x01	1	2	2	10	10
<b>TOTALS</b>		157	—	134,575	—	135,831

**Note:** 'Frame bytes/pkt' = payload + 8 bytes of framing overhead (SOF + cmd + seq(2) + len(2) + CRC(2)). 'Total on wire' = frame bytes × packet count. Actual session total also includes radio response packets (same structure), approximately doubling the wire volume.

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*End of Data Structure Reference*