

## FEATURES

- No operating licence required.
  - Up to 32 RF channels set by DIL switches or serial port.
  - Range 10-20km line of sight, 1-3km in buildings.
  - Type approved to MPT1329 and European ETSI 300-220
  - RF frequency range:
    - UK 458.500 MHz to 458.950 MHz
    - World 400.000 MHz to 480.700 MHz
    - in 1 MHz bands
  - RF power output: 5mW to 500mW.
  - Up to:
    - 9600 Bits/sec at 25KHz channel spacing.
    - 4800 Bits/sec at 12.5KHz channel spacing
- Voltage range: 8.5V to 14V  
Current consumption: Transmit <350mA  
Receive <70mA  
Standby <5mA
- Size: 93mm by 60mm by 17mm  
Antenna Connection: MCX



## DESCRIPTION

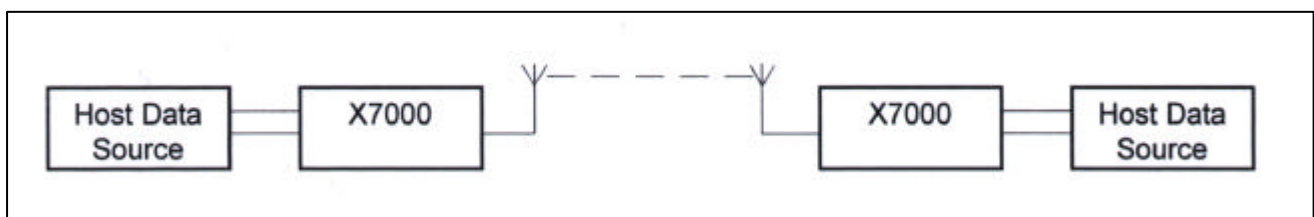
The X7000 Synthesised Data Radio module can be easily integrated into existing products and provides a flexible low cost means for transmitting analogue or digital data over distances of approximately 20 kilometres in free space or 1 to 3 kilometres in buildings.

Signals to and from the X7000 Data Radio are presented on the 26 way PCB connector on the bottom of the module. The transmitter section has three data inputs: one for Analogue Data (AIN), one for Digital Data (DIN) and one for Direct Modulation (MIN). Two data outputs are provided from the receiver section, these are: Digital Data Out (DOUT) and Analogue Data Out (AOUT). The transmitter and receiver can be switched independently by signals (TXON) and (RXON). Additional signals are provided such as relative signal strength indication (RSSI), RF Carrier Direct (CD), Synthesiser Locked (RDY) and Out of Lock (OOL).

The RF frequency can be set in three ways. The 6 DIL switches located at the front of the module set the default RF frequency. This can be incremented or decremented by pulsing the input (FINC) in conjunction with the clock input (FCLK). In addition a Serial Data Stream can be used to set the RF frequency directly and interrogate the status of the radio.

The RF output power can be set between 5mW and 500mW by the (RFADJ) signal.

## TYPICAL OPERATION



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## SPECIFICATION

### ABSOLUTE MAXIMUM RATINGS

Storage Temperature..... -30 to +85 Celsius

Operating Temperature..... -10 to +55 Celsius

### DIMENSIONS

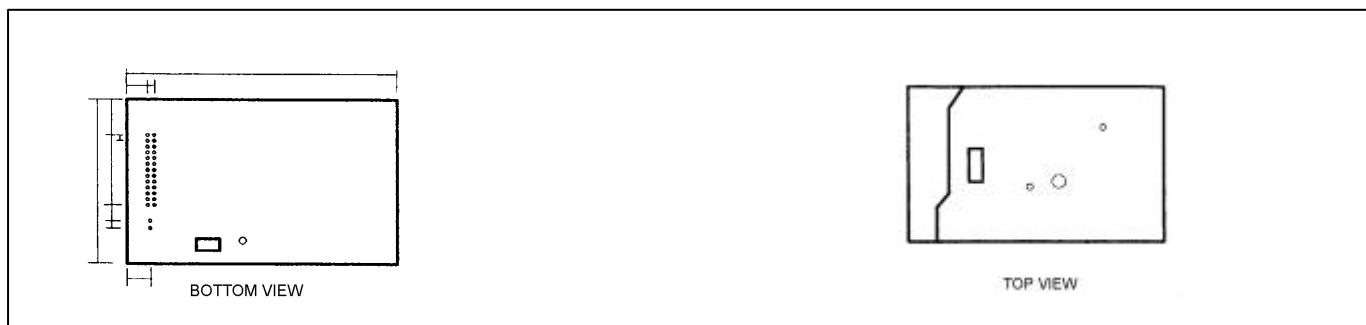
Length = 93mm

Width = 60mm

Height = 17mm

ELECTRICAL CHARACTERISTICS	MIN	TYPICAL	MAX	DIMENSION	NOTE
Frequency Range	458.500		458.950	MHz	UK
	400.000		480.000	MHz	World
Channels		17			
Channel Separation	12.5	25.0	25.0	KHz	
Start up Time	5.0	10.0	30.0	mSecs	
Modulation		F3D			
Power Supply	8.5	12	14	V	
<b>TRANSMITTER</b>					
RF Output Power	5.0	500.0	500.0	mW	
Analogue Input (AIN)		1.0		Vp-p	+/- 3KHz Dev
Digital Input (DIN)	0	5.0	10	V	DC to 10Kbps
Modulation Input (MIN)		3.0		Vp-p	+/- 3KHz Dev
Frequency Deviation		+/- 3.0		KHz	25KHz Channel
Modulation Rate	DC		10.0	Kbps	
Supply Current	290	320	350	mA	at 500mW
<b>RECEIVER</b>					
IF Frequencies		45/455		MHz	
Sensitivity		0.3		$\mu$ V	10dBSINA
Bandwidth	+/- 7.5	KHz			
Analogue Output (AOUT)		1.8		Vp-p	2K impedance
Digital Output (DOUT)	0	5.0		V	
RSSI	0	2.7		V	2.7v = 1mVFS
Supply current	55	65	70	mA	
Standby Current	1	2	3	mA	

## MECHANICAL DETAILS



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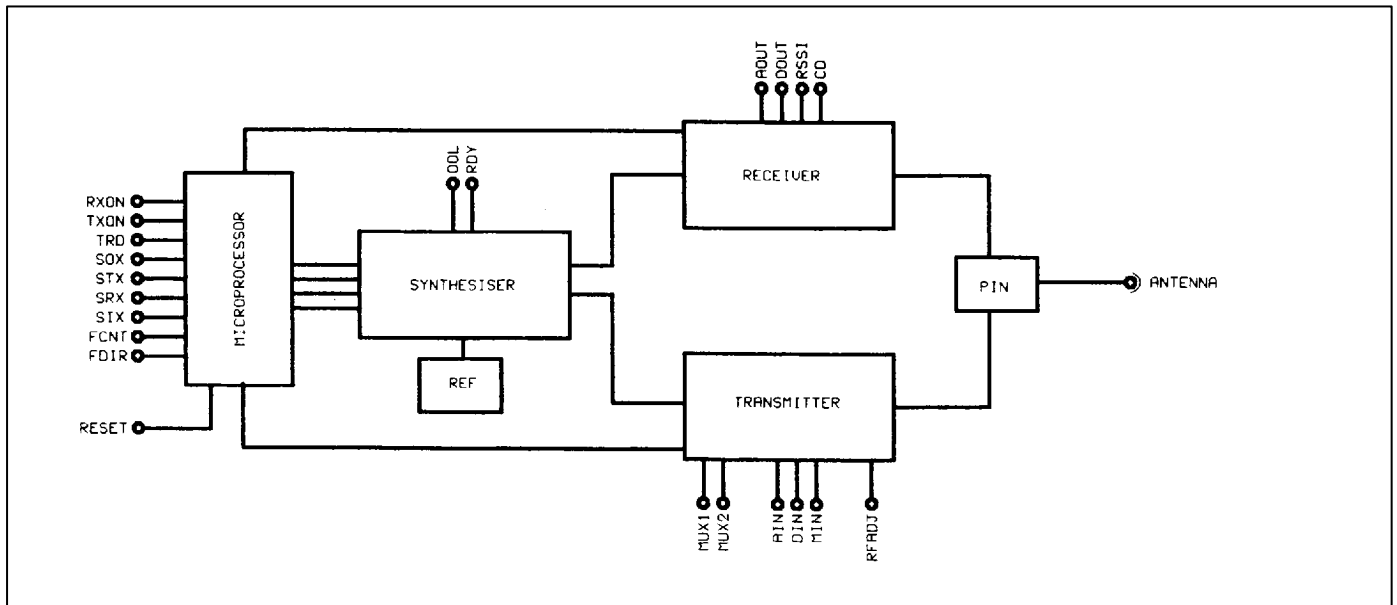
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## CONNECTIONS

PIN	FUNCTION	DESCRIPTION	
1	GRN	0V Power	IN
3	NU	Not Used	
5	OOL	Out of lock. Set low if synthesiser has not locked within 70mSec of TXON or RXON being applied	OUT
7	SOX	Serial status data out. Used in conjunction with SRX	OUT
9	STX	Serial status data. TTL level, 9600 Baud, no parity	OUT
11	SRX	Serial set up data, TTL level, 9600 Baud, no parity	IN
13	TXON	Set low to switch on transmitter	
15	RSSI	Voltage logarithmically proportional to signal strength 0V=No signal; 0.7V = 1mV, 1.6V=10mV, 2.4V=100mV	OUT
17	DIN	Digital data. DC to 10Kbps, 2.5V threshold	IN
19	MIN	Direct modulation. DC to 10Kbps +/-3V p-p full deviation	IN
21	AOUT	Receiver analogue signal	
23	NU	Not Used	
25	DOUT	Receiver digital signal. The ANOUT signal is processed and presented in digital form	OUT
2	RFADJ	Sets the RF power output. Floating = 500mW 0.4V to 0.5V = 5mW to 500mW	IN
4	SIX	Low when serial status data is present on STX	OUT
6	RST	Held low to reset the module	IN
8	RXON	Used in conjunction with TXON	
		TXON      RXON      STATUS	
		Low      Low      Transmit	
		Low      High      Transmit	
		High      Low      Receive	
		High      High      Power Down	
10	FCNT	High to low transition increments or decrements the RF Channel	IN
12	FDIR	HIGH Sets FCNT to increment channel LOW Sets FCNT to decrement channel	IN
14	MUX1	Sets the data inputs to the transmitter as follows	IN
16	MUX2	MUX1      MUX2      INPUT	
		High      High      DIN	
		Low      High      AIN	
		High      Low      MIN	
18	AIN	Analogue Data Signal. Max deviation at 1Vp-p Bandwidth 6Hz to 5KHz, 3K input impedance	IN
20	RDY	Set low when synthesiser has locked	OUT
22	TRD	Set high when in transmit or receive	OUT
24	+Ve	Regulated power supply +ve	IN
26	CD	Carrier detect set high when a RF signal of sufficient strength is present	OUT
A	GRD	0Volts	IN
B	+Ve	8.5V to 14V Ripple free DC power	IN

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## OPERATION

- OOL** The Out of Lock signal is set low by the radio module if the synthesiser has not locked within 70mSec of either TXON or RXON being asserted.
- SOX** The SOX input can be used to send serial commands to the module or pass serial data to the transmitter. The command character 02H sent to SRX will divert all following serial data to the SOX output. This output can be connected to the DIN digital input hence only on serial port is needed to control the radio module status and transmit serial data over the air.
- STX/SRX** The STX output and the SRX input can be used to interrogate the X7000 Radio Module via a serial port and set the following parameters:

- RF Channel Change
- Power Down Mode
- Transmit Mode
- Receive Mode
- Initialise Mode
- Status Report

The SRX port receives serial data from an external source and the STX transmits serial data from the X7000 radio module. Both operate at half duplex, TTL levels, 9600 baud, 8 data bits, 1 stop bit, and no parity. A start bit is defined as a transition from 5V to 0V.

### Serial Protocol

The X7000 Module is interrogated on the SRX pin by the host sending 05H. The module will send an acknowledge byte from STX of 06H.

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The host has 3.6sec to send one of the following command bytes:

49H	Initialise Channels.	Forces both receive and transmit channels to the channel set on the DIL switches.
4CH	Change Channel.	If this character is sent the module will expect two further bytes of data. The first byte will set the RF transmission frequency. The second byte will set the RF receive frequency. The channel bytes are shown in the DIL Switch Table.
50H	Power Down Mode.	The module will disable the transmitter and receiver thereby reducing the current consumption to approximately 2mA.
54H	Transmit Mode.	Enables the transmitter. Data on DIN, AIN or MIN will be broadcast.
52H	Receiver Mode.	Enables the Receiver. Received data will appear on AOUT and DOUT.
53H	Status Report.	Four bytes will be transmitted by the module indicating the current status: Acknowledge 53H Transmission channel number Receiver channel number Module Status: 00H Module powered down 02H Receive mode 04H Transmit mode 22H Receiver synthesiser not locked 32H Transmitter synthesiser not locked

TXON The TXON input is set low to switch on the transmitter stage.  
RSSI The relative signal strength indication provides a voltage that is logarithmically proportional to the RF signal strength:

0.0V = No	RF signal strength
0.7V = 1mV	RF signal strength
1.6V = 10mV	RF signal strength
2.4V = 100mV	RF signal strength
2.7V = 1V	RF signal strength

DIN The digital modulation input accepts digital serial data from DC to 10Kbps. It has a threshold of 2.5V with an input impedance of 100K.

MIN The MIN input can be used to directly modulate the transmitter. A 3Vp-p signal on a 2.5V bias to infringe the MPT1329 specification on adjacent channel power limits. If this input is used the equipment might have to be type approved again.

AOUT A demodulated analogue signal is presented. A full deviation of +/-3KHz will produce a 1.8Vp-p signal on a 2.8V dc bias.

DOUT The DOUT output signal is a digitalised version of the AOUT analogue signal. The peak and trough and the digitised DOUT signal is produced.  
When transmitting a long data stream it is important to transmit an equal mark and space ratio if such as 55H, AAH or CCH is required at the start of each data stream so that the midway level can be established before the data is received.

RFADJ The RF output power can be regulated from this input. An open circuit will produce the maximum output power of 500mW. If 0V is applied to RFADJ then the minimum output power of 5mW will be set.

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The RF output power can be adjusted between the maximum and minimum by setting a voltage of between 0.4V to 0.5V. This adjustment will be affected by both component tolerance and temperature.

SIX The SIX output is set low when data is present on the STX output.  
RST The RST input when held low will reset the internal microprocessor.  
RXON The RXON input is used in conjunction with the TXON input to switch the module into the receive mode, the transmit mode or the standby mode in the following way:

TXON	RXON	FUNCTION
Low	Low	Transmit
High	Low	Receive
Low	High	Transmit
High	High	Power Down

FCNT The FCNT input is used in conjunction with the FDIR input to increment or decrement the RF channel by means of an external switch closure. The input has internal switch de-bounce and a transition from high to low will cause the RF channel to change.

FDIR The FDIR input sets the direction in which the RF channel will change. If FDIR is high then when FCNT is changed from high to low the RF channel will be incremented. If FDIR is low then when FCNT is changed from high to low the RF channel will be decremented.

MUX1/MUX2 MUX1 and MUX2 are used to connect one of the three data inputs to the transmitter in the following way:

MUX1	MUX2	INPUT
High	High	DIN
Low	High	AIN
High	Low	MIN

AIN The AIN input accepts analogue modulation data. A 1Vp-p signal will cause a maximum frequency deviation of +/- 3KHz. The input has a bandwidth of 6Hz to 5KHz with an input impedance of 3K.

RDY The RDY output is set low when the synthesiser has locked. In the transmit mode RDY can be used to give an indication that the module is ready to transmit data. If the module is switched on or from the standby mode to the receive mode, RDY can be used to indicate that the receiver is operational.

TRD The TRD output is set high when the module is in the transmit mode or the receive mode.

+VE The +VE input is the second of two directly connected supply inputs. A regulated 8.5V to 14V power supply capable of supplying the following current:

Transmit Mode	350mA (inrush current = 700 mA for 20msec.)
Receive Mode	70mA
Standby Mode	2mA

The power supply should have a ripple voltage of <50mV on load. Some switch mode power supplies can produce RF frequencies that will cause interference to the receiver signal.

CD The CD output is set high when the receiver detects an RF carrier. The threshold is factory set to 2mV but this can be adjusted to be more or less sensitive by a potentiometer on the underside of the module.

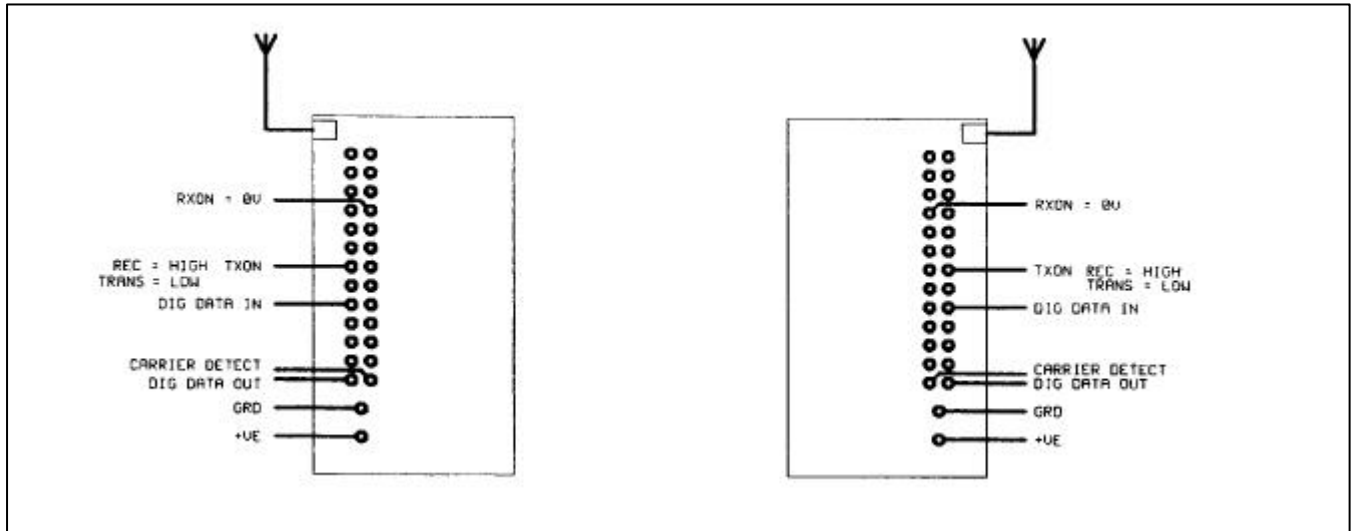
**NOTE:** All digital inputs are pulled up via 100K resistors. They should not be connected directly to the power rail.

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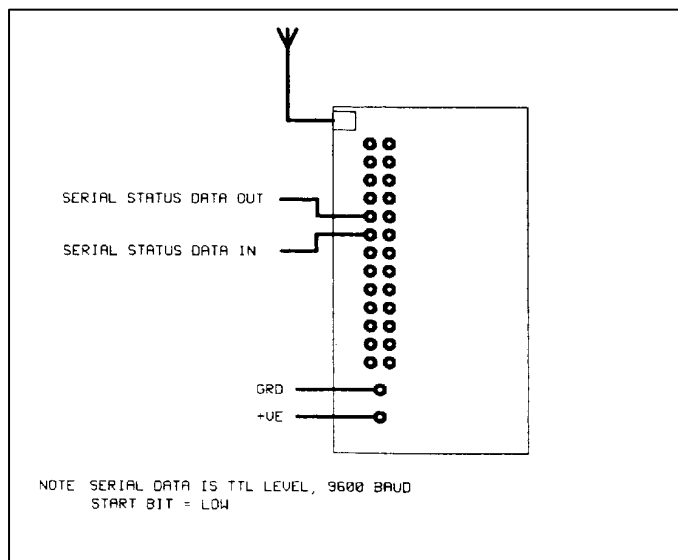
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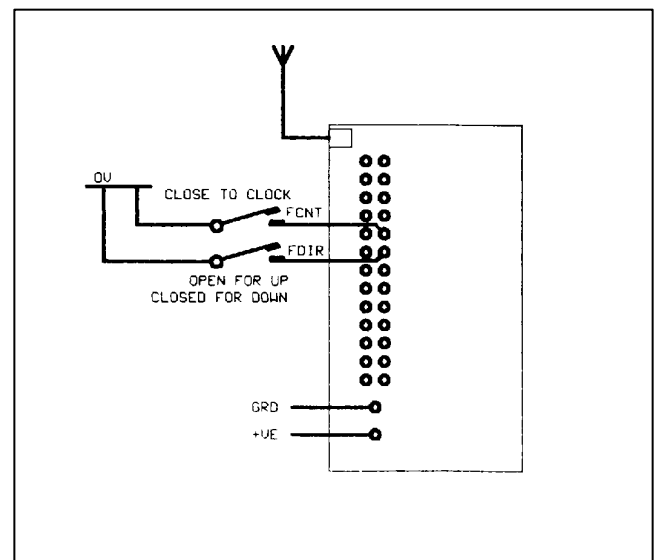
## BASIC RECEIVER



## SERIAL CONTROL



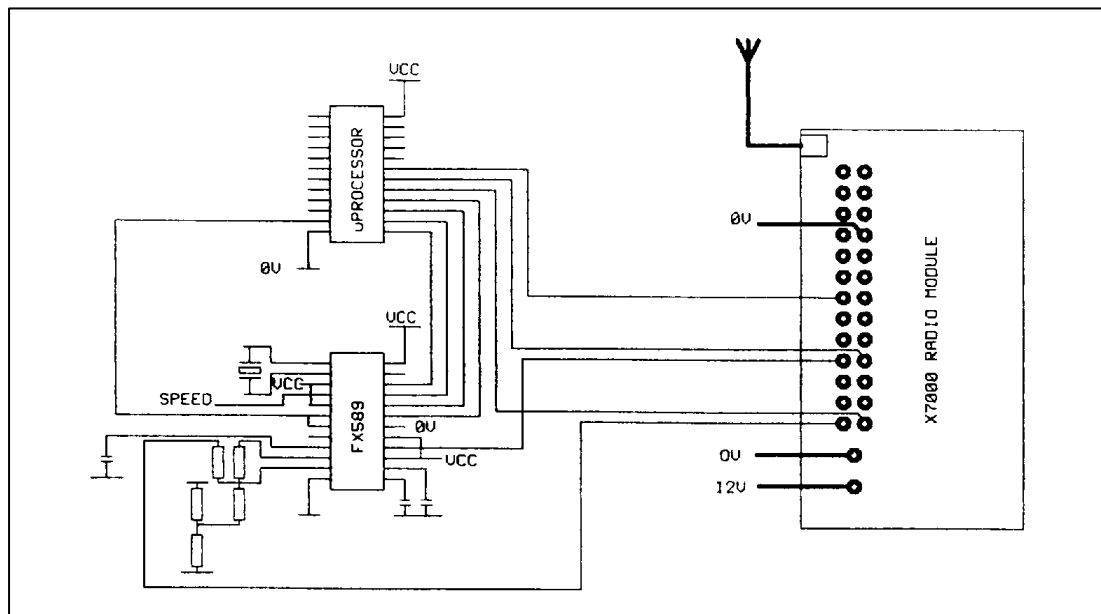
## SWITCH CONTROL



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## FX589 MODEL / X7000 COMBINATION



### DIL SWT

The 5 DIL switches accessed from the top of the module set the RF frequency after power is applied or a RST has occurred. The following frequencies will be set on the standard UK version:

HEX Channel	RF Frequency	SWITCH				
		SW5	SW4	SW3	SW2	SW1
02H	458.525 MHZ	ON	ON	ON	ON	OFF
04H	458.550 MHZ	ON	ON	ON	OFF	ON
06H	458.575 MHZ	ON	ON	ON	OFF	OFF
08H	458.600 MHZ	ON	ON	OFF	ON	ON
0AH	458.625 MHZ	ON	ON	OFF	ON	OFF
0CH	458.650 MHZ	ON	ON	OFF	OFF	ON
0EH	458.675 MHZ	ON	ON	OFF	OFF	OFF
10H	458.700 MHZ	ON	OFF	ON	ON	ON
12H	458.725 MHZ	ON	OFF	ON	ON	OFF
14H	458.750 MHZ	ON	OFF	ON	OFF	ON
16H	458.775 MHZ	ON	OFF	ON	OFF	OFF
18H	458.800 MHZ	ON	OFF	OFF	ON	ON
1AH	458.825 MHZ	ON	OFF	OFF	ON	OFF
1CH	458.850 MHZ	ON	OFF	OFF	OFF	ON
1EH	458.875 MHZ	ON	OFF	OFF	OFF	OFF
20H	458.900 MHZ	OFF	ON	ON	ON	ON
22H	458.925 MHZ	OFF	ON	ON	ON	OFF

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