

## KTX2

Issue 1, 30 July 2012

## UHF FM Code-Hopping Data Transmitter Module

*The KTX2 is a miniature PCB mounting code-hopping UHF radio transmitter suitable for use in secure remote keyless control applications at distances up to 75 metres in-building or 300 metres open ground.*



Figure 1: KTX2-433

### Features

- Designed for compliance with EN 300 220-3 and EN 301 489-3
- Each transmitter module is pre-programmed and unique
- No additional circuitry required to use the module
- 32-bit encryption – more than 4 billion combinations
- Usable range up to 300m
- Available at 433.92MHz
- Fully screened module
- Suitable for use with a Radiometrix KRX receiver-decoder

The module combines full screening with extensive internal filtering for EMC - minimising spurious radiations and susceptibilities. The KTX2 module will suit wireless control links in applications including car and building security and secure unidirectional remote process control. Because of the small size and low power requirement the module is ideal for use in portable, battery-powered devices such as hand-held remote controls requiring data integrity and high security.

### Technical Summary

- Crystal-locked PLL
- FM data with Manchester encoding
- Operation from 3V to 6V
- +3dBm output on 433.92MHz
- <1uA standby, 8mA Tx current
- Supply status included in transmission

## Functional and operational description

The KTX2 transmitter module is a crystal based PLL controlled FM code-hopping transmitter with a pre-programmed Electronic Serial Number (ESN), operating between 3V and 6V supply, at 433.92MHz. KTX2 is designed to meet or exceed EN 300 220-3 standards for European use and delivers nominally +3dBm at 8mA (for 5V supply). The module measures 36.2 x 15.2 x 4.5 mm.

The module is very easy to use: there are no modulation input or transmitter-enable pins. The activation of any combination of the four function lines (S0 – S3) causes a data transmission, part of which is the status of S0 – S3, i.e. the function code. In this way, up to 15 different control combinations can be sent from one module. Simple pushbuttons can be connected directly between S0 – S3 and Vcc if desired. The module will transmit repeatedly whilst any of the function lines is held high for up to 30 seconds (approx.), when a power-saving time-out feature is activated.

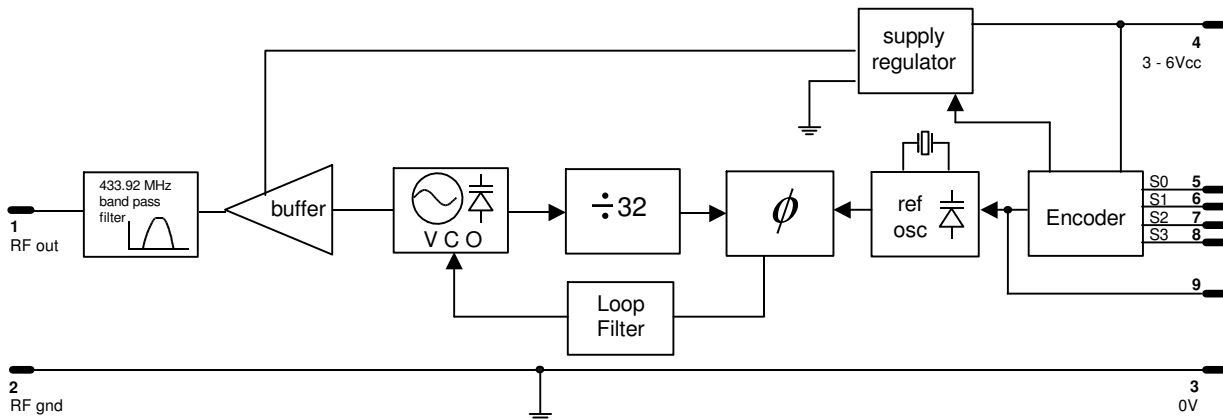


Fig. 2: KTX2 block diagram

### Pin description:

#### RF OUT (pin 1)

50Ω RF output to the antenna. Internally DC-isolated. See antenna section of apps notes for details of suitable antennas.

#### RF GND (pin 2)

RF ground, internally connected to the module screen and pin 3 (0V). This pin should be directly connected to the RF return path - e.g. coax braid, main PCB ground plane etc.

#### 0V (pin 3)

DC supply ground. Internally connected to pin 2 and module screen.

#### Vcc (pin 4)

+3V to +6V DC supply. Max ripple content 0.1V<sub>p-p</sub>. Decoupling is not generally required.

#### S0 (pin 5)

Input (0) – activate high (>0.55V<sub>cc</sub> – V<sub>cc</sub>) to cause a transmission.

#### S1 (pin 6)

Input (1) – activate high (>0.55V<sub>cc</sub> – V<sub>cc</sub>) to cause a transmission.

#### S2 (pin 7)

Input (2) – activate high (>0.55V<sub>cc</sub> – V<sub>cc</sub>) to cause a transmission.

#### S3 (pin 8)

Input (3) – activate high (>0.55V<sub>cc</sub> – V<sub>cc</sub>) to cause a transmission.

#### Internal Use (pin 9)

Modulation (Data). This pin is connected to the modulation input of the Transmitter, therefore do not connect anything to this pin during operation of the module.

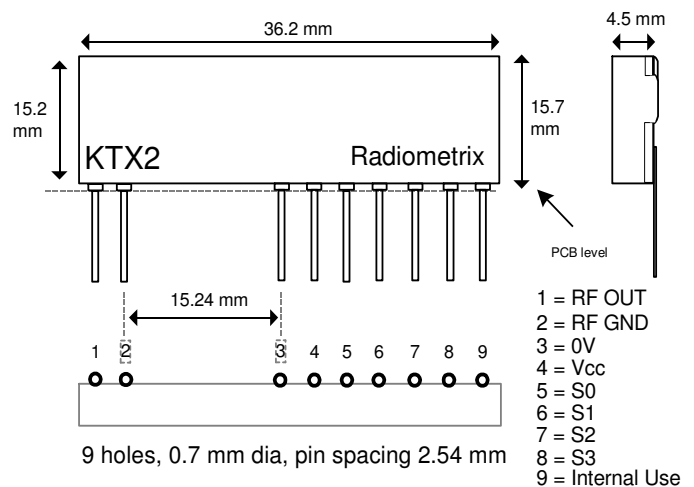


Fig 3: KTX2 physical dimensions

## Notes on the KTX2:

1. The Module will transmit if any of the function lines (S0 – S3) is activated (high).
2. Single message time is typically 150ms.
3. Whilst S0 – S3 are all deactivated (low) standby current consumption is <1uA.
4. The Module will transmit the same message (with the same hop-code) repeatedly whilst any of the function lines are held active high, until power-saving time-out occurs after approx. 30s.
5. When the power-saving timeout occurs, current consumption will be <350uA, until all function line(s) are released again.
6. Whilst a function line is held high, if another function line is taken high then the function code in the message changes to reflect the new state of the function lines and the hop-code is also changed – as if the user had released all function lines and activated the new combination.
7. Releasing individual function lines (whilst at least one function line remains high) has no effect on the transmitted message.
8. The supply monitoring status bit is set when module supply drops below 3.8V (approx.) and resets when supply falls even further – below 2.2V (approx.) – but note that this is less than the minimum supply recommended for use with KTX2.

## Description of the KTX/KRX code hopping system:

Every time a function code is activated causing KTX to transmit, a hop-code is generated. The hop-code is an encryption based upon a Manufacturer code and the module ESN (unique to each module). An encryption algorithm uses these two variables to generate the hop-code, which will change for every new transmission. Note that the data itself (i.e. the function code) is not encrypted, as it is the identity and status of the sender that is used to safeguard operation of the system.

At the KRX receiver-decoder, the hop-code can only be decrypted with the correct key. The key is derived from the manufacturer code and the KTX serial number. The manufacturer code is not transmitted: it is pre-programmed into the decoder. Because the hop-code is changed for every new transmission the receiver decoder must be synchronised to the transmitter encoder. This is achieved by “learning” the transmitter to the receiver during which the serial number and synchronisation data is stored in the receiver-decoder. Transmissions received from all KTX modules are decoded, but not acted upon unless the serial number has been learned first and the decoder is synchronised to the encoder.

If the Radiometrix KRX decoder loses synchronisation with the transmitter (e.g. repeated transmitter activation whilst out of range) then the KTX module must be activated twice before the decoder will allow the control to be processed, but only if the KTX module is within a *forward* window of +32768 activations. This mechanism prevents “code-grabbers” from breaking the security of the system by recording and re-broadcasting old codes. Additionally, in the KRX decoder a window exists allowing up to 14 transmissions to occur whilst the transmitter is out of range before two valid sequential transmissions are required to use the system. In practice a user may not notice the latter, since human reaction to an unsuccessful attempt is simply to “press the button again”.

## Absolute maximum ratings

### Survival Maximums:

Exceeding the values given below may cause permanent damage to the module.

Operating temperature -	-20°C to +70°C
Storage temperature	-40°C to +100°C
Vcc (pin 4)	-0.3V to +6.9V
Function input (pins 5-8)	Vcc +/-0.3V
RF out (pin 1)	±50V DC 10dBm RF

### Performance Specifications: KTX2 transmitter.

(Temperature = 20°C unless stated)

	pin	min.	typ.	Max.	units	notes
<b>DC LEVELS</b>						
supply voltage	4	3.0	4.5	6.0	V	3
<b>CURRENT &amp; RF POWER</b>						
<i>KTX2-433</i>						
supply current @ Vcc = 5V	4	6	8	10	mA	
RF power @ Vcc = 3 – 6V	1	+1	+3	+5	dBm	1
Standby current			<1uA			
<b>RF</b>						
harmonics < 1GHz	1	-	-46		dBc	1
harmonics > 1GHz	1	-	-46		dBc	1
initial frequency accuracy	-	-15	+/-10	+15	kHz	
overall frequency accuracy	-	-25	+/-10	+25	kHz	2
FM deviation (+/-)	-	20	27	35	kHz	

#### Notes:

1. Measured into a 50Ω load.
2. -20 to +70°C @ Vcc = 5V
3. Operational at 2.8V but with reduced deviation (typ. +/-15kHz)

## Power supply requirement

The KTX2 module incorporates a built-in regulator which delivers a constant 2.8V supply to the RF circuitry when the external supply voltage is 2.85V or greater, with 40dB or more of supply ripple rejection. This ensures constant performance up to the maximum permitted supply rail and removes the need for external supply decoupling except in cases where the supply rail is extremely poor (ripple/noise content >0.1Vp-p).

Note, however, that for supply voltages lower than 2.85V the regulator is effectively inoperative and supply ripple rejection is considerably reduced. Under these conditions the ripple/noise on the supply rail should be below 10mVp-p to avoid problems. If the quality of the supply is in doubt, it is recommended that a 10 $\mu$ F low-ESR tantalum or similar capacitor be added between the module supply pin (Vcc) and ground, together with a 10 $\Omega$  series feed resistor between the Vcc pin and the supply rail.

The module current in standby mode (Vcc applied, S0, S1, S2, S3 all at 0V) is less than 1 $\mu$ A.

The KTX2 incorporates a low voltage shutoff circuit, which prevents any possibility of erratic operation by disabling the RF output if the supply voltage drops below 2.2V ( $\pm 5\%$ ). This feature is self-resetting, i.e. restoring the supply to greater than 2.2V will immediately restore RF output from the module.

## Module mounting considerations

The module may be mounted vertically or bent horizontal to the motherboard. Good RF layout practice should be observed – in particular, any ground return required by the antenna or feed should be connected directly to the RF GND pin at the antenna end of the module, and not to the OV pin which is intended as a DC ground only. All connecting tracks should be kept as short as possible to avoid any problems with stray RF pickup.

If the connection between module and antenna does not form part of the antenna itself, it should be made using 50 $\Omega$  microstrip line or coax or a combination of both. It is desirable (but not essential) to fill all unused PCB area around the module with ground plane.

**Warning:** DO NOT wash the module. It is not hermetically sealed.

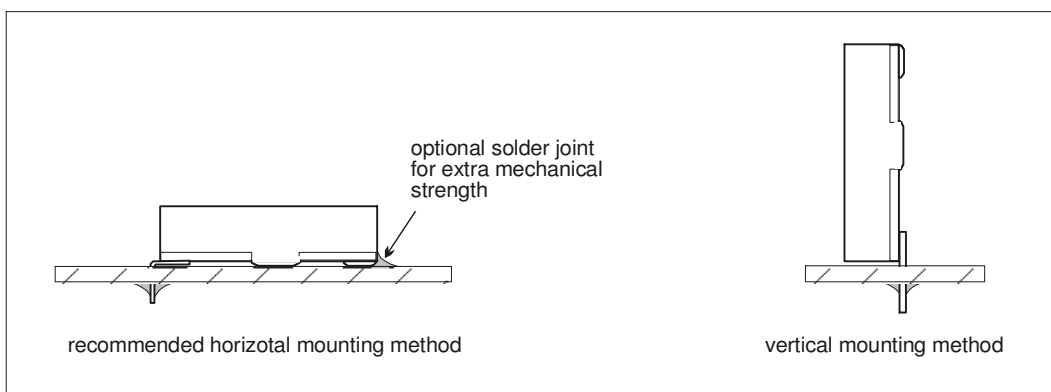


Figure 4: Module mounting options

## Antenna requirements

Three types of integral antenna are recommended and approved for use with the module:

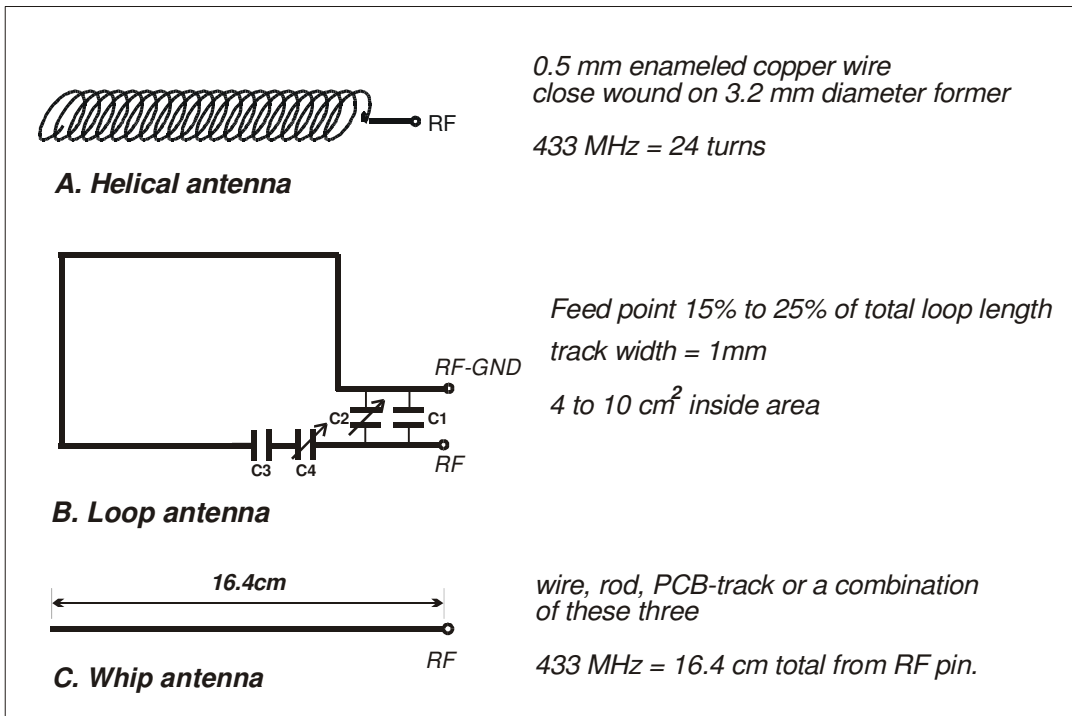


Fig.5: Antenna configuration

Feature	A	B	C
	<i>helical</i>	<i>loop</i>	<i>whip</i>
Ultimate performance	**	*	***
Easy of design set-up	**	*	***
Size	***	**	*
Immunity proximity effects	**	***	*
Range open ground to similar antenna (for KTX2-433 & RX2A-433-10)	200m	100m	300m

### Antenna selection chart

- A) *Helical* Wire coil, connected directly to pin 2, open circuit at other end. This antenna is very efficient given it's small size (20mm x 4mm dia.). The helical is a high Q antenna, trim the wire length or expand the coil for optimum results. The helical de-tunes badly with proximity to other conductive objects.
- B) *Loop* A loop of PCB track tuned by a fixed or variable capacitor to ground at the 'hot' end and fed from pin 2 at a point 20% from the ground end. Loops have high immunity to proximity de-tuning.
- C) *Whip* This is a wire, rod, PCB track or combination connected directly to pin 2 of the module. Optimum total length is 15.5cm (1/4 wave @ 433MHz). Keep the open circuit (hot) end well away from metal components to prevent serious de-tuning. Whips are ground plane sensitive and will benefit from internal 1/4 wave earthed radial(s) if the product is small and plastic cased

The antenna choice and position directly controls the system range. Keep it clear of other metal in the system, particularly the 'hot' end. The best position by far, is sticking out the top of the product. This is often not desirable for practical/ergonomic reasons thus a compromise may need to be reached. If an internal antenna must be used try to keep it away from other metal components, particularly large ones like transformers, batteries and PCB tracks/earth plane. The space around the antenna is as important as the antenna itself.

## ***Duty Cycle requirements***

The duty cycle is defined as the ratio, expressed as a percentage, of the maximum transmitter “on” time on one or more carrier frequencies, relative to a one hour period. Where an acknowledgement message is required, the additional transmitter “on” time shall be included.

There is a 10% duty cycle restriction on 433.050-434.790 MHz band in most of the EU member states.

The KTX2-433 is a RF module intended to be incorporated into a wide variety of applications and finished products, Radiometrix has no control over the end use of the KTX2-433. The harmonised band 433.050 to 434.790 MHz as detailed in Annex 1 Band E of CEPT/ERC Recommendation 70-03 (which can be downloaded at <http://www.ero.dk/scripts/docmanag98/dm.dll/QueryDoc?Cat=Recommendation>) has list of countries where Duty Cycle restriction apply.

Module users should, therefore, ensure that they comply with the stated Duty Cycle requirements of the version of CEPT/ERC Recommendation 70-03 in place at the time of incorporation of the KTX2-433 into their product. It should be noted that the stated Duty Cycle must not be exceeded otherwise any approval granted for the KTX2-433 will be invalidated.

## ***Variants and ordering information***

*The KTX2 is available as a standard version:*

### **KTX2-433**

The standard frequency is 433.92MHz, for other frequency variants, please contact sales department.

For all other variants please contact Sales department.

## ***To make a complete code-hopping system:***

Suitable Receiver module to use with KTX2:

### **RX2A-433-10**

Suitable Decoder IC for use with RX2A:

### **KRX416-000-DIL**

Or use a complete relay output board (includes RX2A module) for use with KTX2 modules (mapping the four KTX2 function lines to four change-over relays)

### **KDEC-433-000**

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The Intrastat commodity code for all our modules is: 8542 6000

## R&TTE Directive

After 7 April 2001 the manufacturer can only place finished product on the market under the provisions of the R&TTE Directive. Equipment within the scope of the R&TTE Directive may demonstrate compliance to the essential requirements specified in Article 3 of the Directive, as appropriate to the particular equipment.

Further details are available on The Office of Communications (Ofcom) web site:

<http://www.ofcom.org.uk/>

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