# SMARTALPHA RF TRANSCEIVER

- Intelligent RF Modem Module
- RF Data Rates to 19200bps
- Up to 300 metres Range
- Programmable to 433, 868, or 915MHz
- Selectable 'Narrowband' RF Channels
- Crystal Controlled RF Design
- Supply Voltage 3.3V
- Serial Data Interface with Handshake
- Host Data Rates up to 38,400 Baud
- Very Stable Operating Frequency
- Low Profile Ceramic DIL Package
- Operates from –20 to +70 $^{\circ}$C
- Evaluation Board for Rapid Development
- Software Configurable
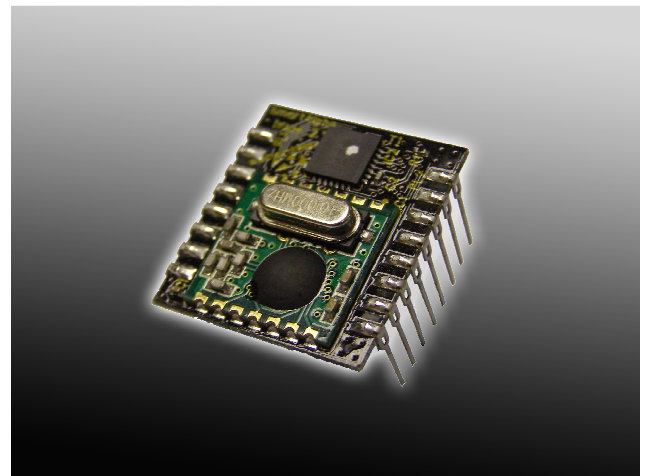
Operating Modes
- Point to Point
- Broadcast
- One to Many Network
- Many to One Network

Applications
- Wireless Security Systems
- EPOS Terminals
- Sensor Data logging
- Remote Telemetry & Telecommand
- Remote Meter Reading

Description

The SMARTALPHA Radio Modem module provides a simple interface wireless communications module for the transfer of data at of up to 19200bps. Its unique features of narrow band operation and user channel selection combined with excellent interference rejection make them an ideal choice for next generation applications.
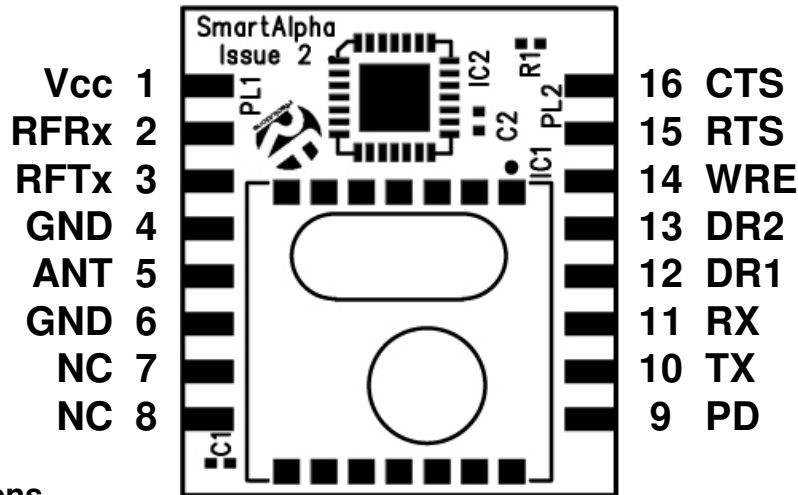
The transceivers have the functions of a complete radio modem and simply require CMOS/TTL data at the transmit input and the corresponding transceiver(s) output the same data. Preamble and CRC are automatically generated and added to the RF signal

Possible applications include one-to-one and multi-node wireless links in applications including car and building security, EPOS, inventory tracking, remote industrial process monitoring and computer networking. Because of their small size and low power requirements, both modules are ideal for use in portable, battery-powered applications such as hand-held terminals.

Part Numbering

Part Number	Description
SMARTALPHA -433	Smart Radio Transceiver Module, 433MHz
SMARTALPHA -868	Smart Radio Transceiver Module, 868MHz
SMARTALPHA-EVAL	Evaluation Host PCB for SMARTALPHA Module (Requires Module)

Table of Contents

1. Module Connections

```
SmartAlpha
Issue 2
Vcc  1                              16  CTS
RFRx 2                              15  RTS
RFTx 3                              14  WRE
GND  4                              13  DR2
ANT  5                              12  DR1
GND  6                              11  RX
NC   7                              10  TX
NC   8                               9  PD
```

Pin Descriptions

Pin Number	Name	Type	Description
1	**Vcc**	Power	Positive supply voltage connection. Decouple with 100n ceramic capacitor to ground.
2	**RFRx**	Out	RF Data receive signal Active Low
3	**RFTx**	Out	RF Data transmit signal Active Low
4, 6	**GND**	Power	Connect to 0 volts.
5	**Antenna**	In / Out	Nominal 50 ohm input/output impedance capacitively isolated from the internal circuit.
7, 8, 14	**reserved**	-	Don't connect
9	**PD**	In	Power Down pin. Take low for low power standby mode.
11	**Rx**	Out	Received data output to host controller (CMOS logic out) representing true data as supplied to the transmitter.
10	**Tx**	In	Transmit data input from host controller. Data input to the transmitter can be directly interfaced to CMOS logic drive operating on the same supply voltage as the transceiver.
12, 13	**Data Rate**	In	Host Data Rate selection.
14	**WRE**	In	When High configuration data is stored in EEPROM. When Low configuration data is held in Volatile memory and lost on power cycle. To be used If configuration is changed regular on the fly.
15	**RTS**	In	Logic '0' is Request To Send. Take low when the host is ready to send data to the module or is ready to receive data from the module.
16	**CTS**	Out	Logic '0' is Clear To Send. Taken high when the module is busy.

Host Data Rate Selection

DR2 (pin 13)	DR1 (pin12)	Baud Rate
0	0	4,800
0	1	9,600
1	0	19,200
1	1	38,400

2.   Operation

The Host Data Rate pins are read when the PD pin goes high. The SmartALPHA must be put into standby mode by taking the PD pin low in order to change the selection.

The SmartALPHA contains an on-board data buffer equal to two data packets. Therefore if RTS is asserted (then the host is unable to receive data) the SmartALPHA will store a max of two data packets, all further data packets received will be discarded.

No RF packets will be received by the module when it is in power down standby mode.

Each SmartALPHA has its own preset address. This is set during configuration. Any data received is examined and the address header embedded within the data packet is compared with the RF60 address. Only data received with matching address will be processed and output to the host, all other data will be discarded. All SmartALPHA modules are shipped with a default address of 7E7E7E7E.

Operation Modes

The addressing protocol employed enables many different configurations such including:
one-to-one operation; for point to point data communication
broadcast operation; where a single master address many SmartALPHA modules concurrently. (using many SmartALPHA modules set to the same address),
one-to-many; A network consisting a master and many slaves (the receivers all have the same address)
many-to-one; where the transmitters all send to a single receiver address.
Because each SmartALPHA can contain a unique address, multiple SmartALPHA networks can co-exist in the same area.

Serial Data Format

The SmartALPHA serial format settings are:
Baud Rate: Defined by DR1 and DR2 Pins
Data Bits: 8
Parity:None
Stop Bits: 1
Flow Control: Hardware

CTS Timing

With a standard buffer size of 64 bytes, CTS is asserted 20uS after the buffer is full. In cases where less than 64 bytes are sent CTS is asserted after a timeout of 6mS.

3. Configuration

The configuration of the SmartALPHA module may be changed by placing the SmartALPHA in Configuration mode, then sending a set of configuration data bytes to the module on the Tx pin.

To place the SmartALPHA in Configuration mode the user needs to send "+++" (three plus characters) within the 10mS timeout for each character. The SmartALPHA responds be returning the Configuration data bytes. The SmartALPHA is now on Configuration mode.

To exit Configuration mode the user needs to send "---" (three minus characters) within the 10mS timeout for each character. The SmartALPHA will not return a response. The SmartALPHA is now in data mode.

Byte	Name	Description	Default Supplied Value
0	**Destination Address**	MSB	7E hex
1			7E hex
2			7E hex
3		LSB	7E hex
4	**SmartALPHA Address**	MSB	7E hex
5			7E hex
6			7E hex
7		LSB	7E hex
8	**RF Channel high byte**	TX / RX Frequency	06 hex (434.133Mhz)
9	**RF Channel low byte**	TX / RX Frequency	75 hex (434.133Mhz)
10	**Tx Power**	0 = 0 dBm 1 = -3 dBm 2 = -6 dBm 3 = -9 dBm 4 = -12 dBm 5 = -15 dBm 6 = -18 dBm 7 = -21 dBm	0 (0 dBm)
11	**RF transmission speed**	A3 hex = 1200 bps 91 hex = 2400 bps 47 hex = 4800 bps 23 hex = 9600 bps 11 hex = 19200 bps 08 hex = 38400 bps 05 hex = 57600 bps	23 hex

The RF Channel is calculated as:
433 MHz working frequency: Config value (decimal) = ((Fo/10)-43)*4000
868 MHz working frequency: Config value (decimal) = ((Fo/20)-43)*4000
915 MHz working frequency: Config value (decimal) = ((Fo/30)-30)*4000
(Fo = Required Frequency)

Please Note, the calculated value must be converted into binary. The high byte is placed in byte 8 and the low byte in byte 9. The Config value **MUST** be in the range 96 to 3903 (decimal). Both bytes must be present for the channel to be accepted.

While the SmartALPHA is in configuration mode, then the module will send the current configuration back to the host each time a data packet is received. To retrieve the current configuration without changing any options the host can send a single byte to the module and wait for the response.

It is not necessary to send all configuration bytes to the module, but all data sent must be valid. For example to change the destination address the host may just send four bytes. Configuration data excluded from the end of the data stream will be unchanged. The SmartALPHA module will accept a short configuration after a 10ms

timeout after the last byte sent to the module, or when the RTS pin goes high. This allows for the host to easily change the destination address of the RF data packet, thus enabling one SmartALPHA to send individual data to several different recipient modules.

A destination address of 00000000 will reset the SmartALPHA to the default settings shown above.
RF data packets received by the SmartALPHA with the embedded destination address which matches the SmartALPHA address will be accepted, processed and passed to the host, all of the RF data packets will be ignored.

When configuring the destination or SmartALPHA address an incorrect number of bytes for an address will leave the current address unchanged.
An invalid Transmitter Power or Packet Size setting will leave the current setting unchanged.

4.   Application Information

Connection of the SmartALPHA to an RS232 host terminal device such as a PC serial port may easily be achieved using the Application Schematic at the back of this datasheet.
The 9 way 'D' socket (J1) provides the standard pinout required to connect directly to the serial port of any std PC using a 9 way male/female cable. The MAX3232 (a low voltage RS232 line driver) provides level conversion between the RS232 levels on the serial port and the logic levels pins of the SmartALPHA module.
If two such circuits are constructed then it will be possible to interconnect two PC's and test out the performance of the SMARTALPHA. When both circuits are powered up it will be necessary for them to have each others address in the "Destination Address" register.
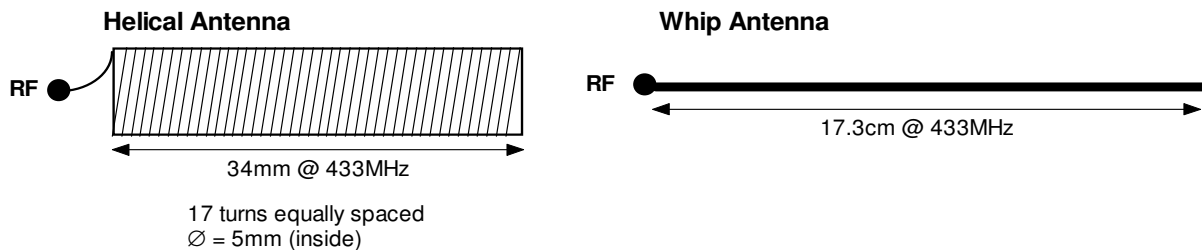
Antenna Design

The design and positioning of the aerial is as crucial as the module performance itself in achieving a good wireless system range. The following will assist the designer in maximising system performance.

The RF ground pin should be connected to a ground plane which should shield the aerial connection and the PCB layout around the aerial track itself should be such as to give a 50 Ohm impedance. The aerial should be kept as far away from sources of electrical interference as physically possible. The specified power supply decoupling capacitors should be placed close to the module as possible and have direct connections to the relevant pins.

The antenna 'hot end' should be kept clear of any objects, especially any metal as this can severely restrict the efficiency of the antenna to receive power. Earth planes restricting the radiation path of the antenna will also have the same effect.

The best range will be achieved with either a straight piece of wire, rod or PCB track @ ¼ wavelength (17.3cm @ 433.92MHz). Increased range may be achieved if this ¼ wave antenna is placed perpendicular to and in the middle of a solid earth plane measuring at least 16cm radius. In this case, the antenna should be connected to the module using 50 Ohm coaxial cable and the PCB track layout tips given above should be observed.

Helical Antenna

RF ●

34mm @ 433MHz

17 turns equally spaced
∅ = 5mm (inside)

Whip Antenna

RF ●

17.3cm @ 433MHz

5. Technical Specifications

Electrical Characteristics

	Min.	Typ.	Max.	Units	Notes
DC Levels					
Supply voltage	2.3	3.3	3.6	V	1
Supply current (Transmit mode)		24	26	mA	
Supply current (Receive mode)		13	15	mA	
Supply current (Standby mode)		250		uA	
Data input/output high	Vcc–0.3		Vcc+0.3V	V	
Data input/output low	0		0.3	V	
RF					
Working frequency: 433MHz Module	430.24		439.7	MHz	2
868MHz Module	860.48		879.5	MHz	2
915MHZ Module	900.72		929.27	MHz	2
Receiver sensitivity		-110		dBm	
Transmitter RF power out	-21		0	dBm	
Frequency deviation	5	15	30	kHz	
GFSK manchester encoded data rate		86.2		kbps	
Operating temperature	-20		+80	Deg C	
Storage temperature	-40		+100	Deg C	
Dynamic Timing					
Power up to stable receiver data out		150		mS	
Power up to full RF out		150		mS	
Standby to Receive mode		1		mS	
Standby to Transmit mode		1		mS	

Notes
1. Supply voltage should have <10mV ripple.
2. The application operating frequency must be chosen to comply with the Short Range device regulation in the area of operation.

Mechanical Detail
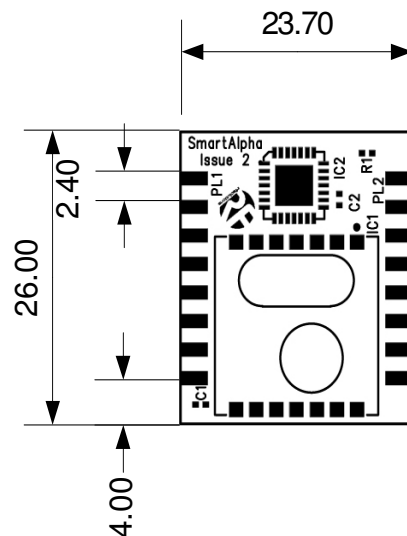
6. Evaluation Board SMARTALPHA-EVAL

ALSO SEE RF SOLUTIONS STORM RADIO MODEM

- Selectable Host Baud Rate 1200bps – 38.4Kbps

- USB or RS232 Cable Replacement

- Range up to 150 Metres

- European Operation 433 or 868MHz

- Narrow Band RF

- RF Data Rates to 100 kbps

- One to Many, Many to One

- 12V or USB Power

- Conforms to ETSI 300-220

- Requires no radio licence to operate

- ABS enclosure
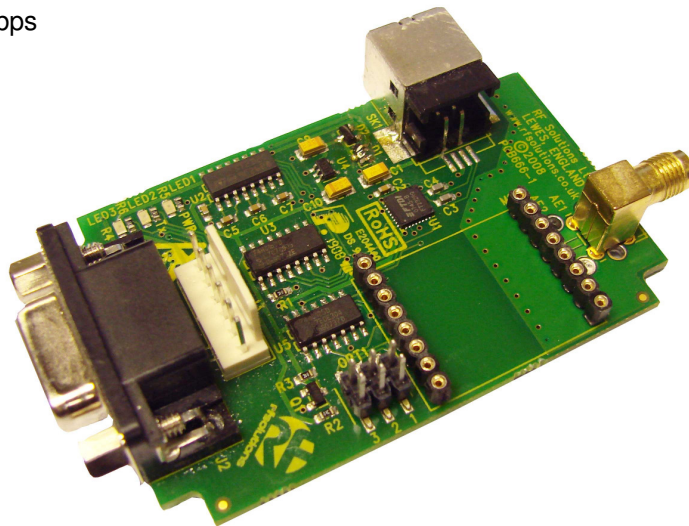
Description

The RF Solutions SMARTALPHA-EVAL radio Modem is a simple to use and very versatile device. It can operate as a one to one cable replacement link, in multiple master/slave arrangements or in broadcast modes. The Small modem come in an ABS enclosure with external antenna and easily achieves a range of 150m.

Multiple connection options allow it connect to a PC or act as an M2M link via USB or RS232 with power though the data cable or via an external 12V DC supply.
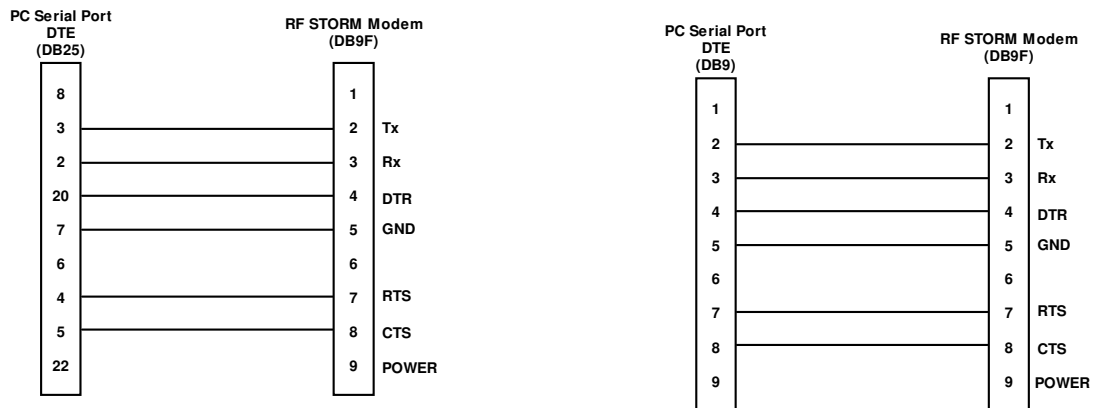
Connections and Set-up

USB Connector

The SMARTALPHA-EVAL interfaces to the host computer via a USB Type A connector.

RS232 Connector

The RF SMARTALPHA-EVAL interfaces to the host computer via an RS232 connection using a standard DB9 connector with pin out as shown in the diagram below.

```
PC Serial Port              RF STORM Modem          PC Serial Port          RF STORM Modem
    DTE                        (DB9F)                   DTE                     (DB9F)
   (DB25)                                              (DB9)

     8                          1                        1                       1
     3 ───────────────────────  2  Tx                    2 ──────────────────    2  Tx
     2 ───────────────────────  3  Rx                    3 ──────────────────    3  Rx
    20 ───────────────────────  4  DTR                   4 ──────────────────    4  DTR
     7 ───────────────────────  5  GND                   5 ──────────────────    5  GND
     6                          6                        6                       6
     4 ───────────────────────  7  RTS                   7 ──────────────────    7  RTS
     5 ───────────────────────  8  CTS                   8 ──────────────────    8  CTS
    22                          9  POWER                 9                       9  POWER
```

Power supply

For USB comms, power is automatically obtained from the USB connection. (No external power required)

For RS232 comms external power is required. Power is provided by either J6 (as shown above)

Serial Data

Data Bits: 8
Parity: None
Stop Bits: 1
    Flow Control: None

OPT 1	OPT 2	OPT 1	Host Baud Rate
Open	Open	Do NOT Fit	38,400
Open	Fitted	Do NOT Fit	19,200
Fitted	Open	Do NOT Fit	9,600
Fitted	Fitted	Do NOT Fit	4,800

Status LED's

The SMARTALPHA-EVAL circuit board has three LED's, representing the following signals:

- **PWR** – Power on
- **Tx** – Transmitting data
- **Rx** – Receiving data

SmartALPHA Configuration Utility

The SMARTALPHA-EVAL modem can be easily configured using the 666-EVAL Configuration Utility available from the RF Solutions Website.

```
Smart Alpha Setup Utility - Version:1.0.103

Modem Setup | Comms Port Setup

Modem Settings

    Destination    ??  ??  ??  ??   0-FF

    Local          ??  ??  ??  ??   0-FF

    Band           433Mhz ▼

    RF Frequency   ??      MHz 430.24-439.75
                                860.48-879.51

    Tx Power       ??     ▼

    RF TX Speed    ??     ▼   BPS

       Set      Reset      Refresh
               Defaults

                            Connect

No Response from Modem. Check Comms Port & Baud rate
```

SmartALPHA Application Example
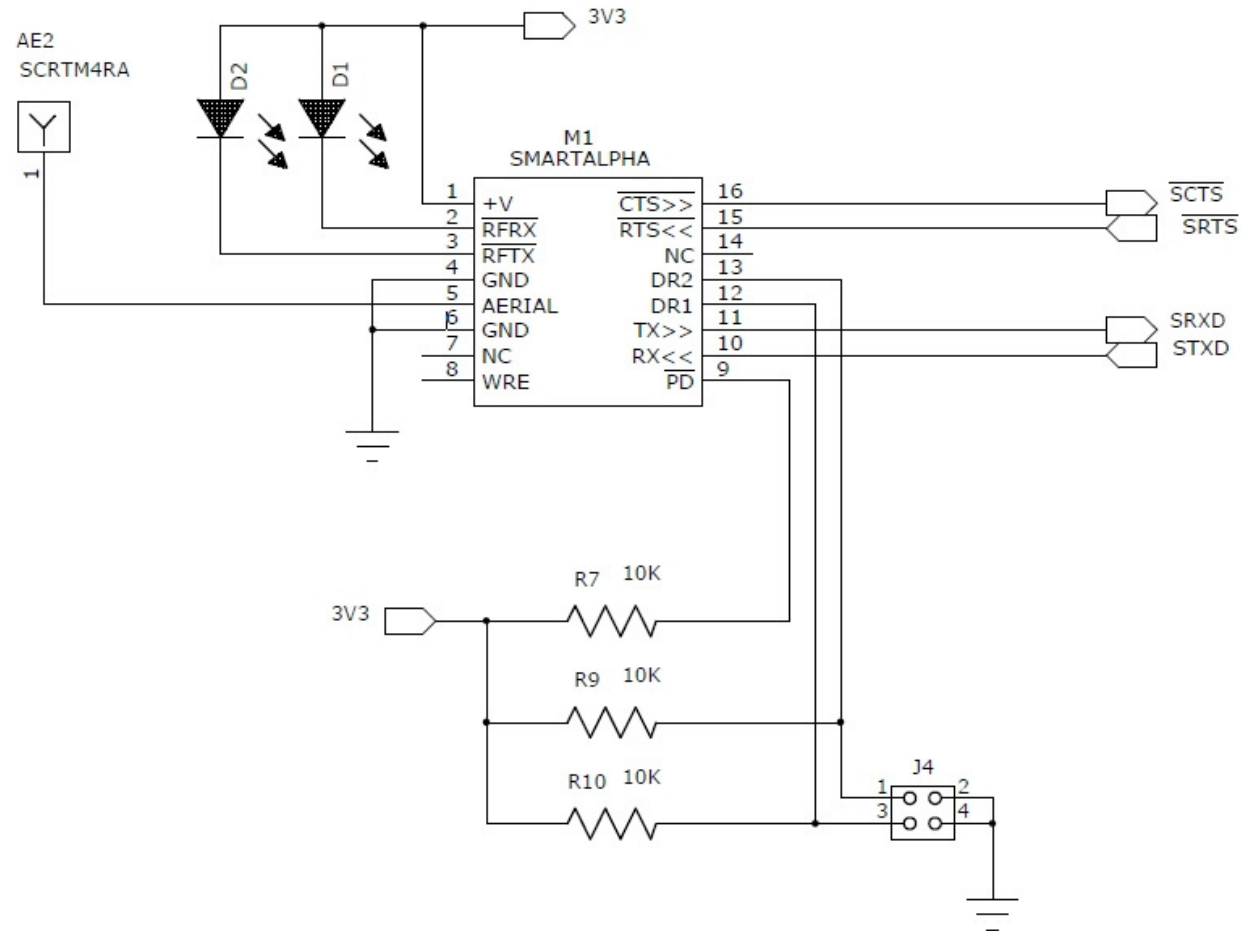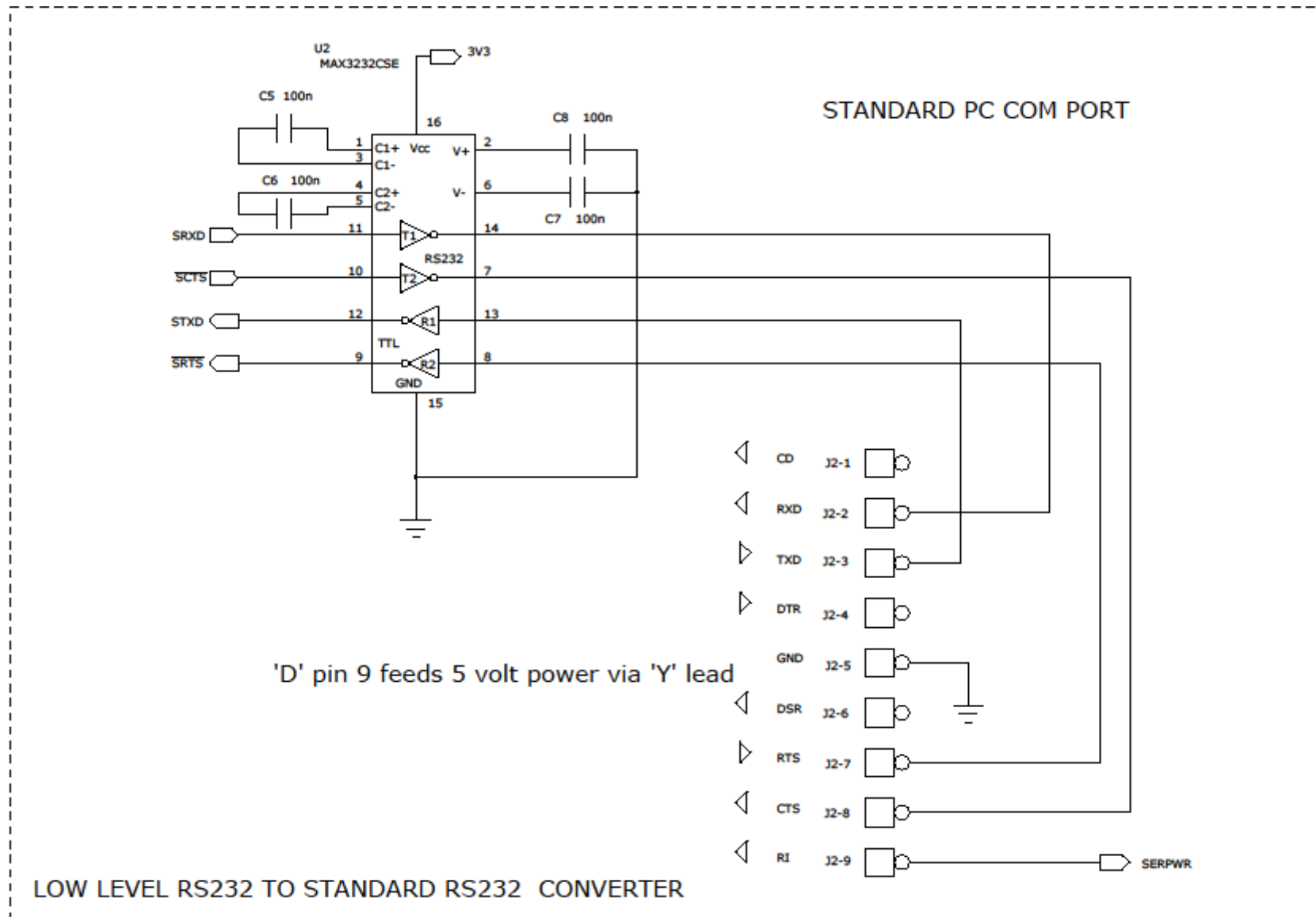
LOW LEVEL RS232 TO STANDARD RS232 CONVERTER

R F Solutions Ltd.,

Unit 21, Cliffe Industrial Estate,

Lewes, E. Sussex. BN8 6JL. England.

Email : sales@rfsolutions.co.uk   http://www.rfsolutions.co.uk