

## Using the NCN6000 Smart Card Interface

### Demo Board V1.1 User Manual

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### APPLICATION NOTE

#### INTRODUCTION

This manual describes a possible application built around the NCN6000. We thank you for choosing an ON Semiconductor part, and we hope this guide will help you to run our demo board. Please use the NCN6000 data sheet as a reference source, document number NCN6000/D, available through the Literature Distribution Center or via our website at <http://www.onsemi.com>.

Among the electrical parameters, the power supply must be capable to yield 100 mA minimum continuous DC current to operate the system properly. Poor power supply generates random lost of transaction with the card and are difficult to fix. In the event of trouble with the transaction, double check the power supply line, particularly the ripple, as high and fast transients are present on this line during the DC/DC operation. Peak current up to 300 mA can be developed when the card operates at full speed.

#### General Demo Board Description

The demo board comes fully assembled, ready to operate, on a 5 × 3 inches board. Included are all the functions needed to evaluate the NCN6000 integrated circuit. The board requires only external DC 8 to 12 Volts 500 mA stabilized power supply. The associated MCU includes the useful NCN6000 routines to set up all the programmable functions.

The board is split into six main sub-circuits as follow:

1. One standard +5 Volts regulator with Schottky reverses polarity protection.
2. The NCN6000 area, with test points and required passive components (L1, C3, C8, C9).
3. The MCU is an MC68HC11 family device.
4. Low current LED's ( $I_f = 2$  mA) are used to display NCN6000 configuration and status.
5. A keyboard to enter all NCN6000 set up combinations.
6. An RS232 communications interface is present to control and download the MCU software.

#### Equipment List to Evaluate the Circuit

- DC Lab power supply (typical: 9 V/500 mA)
- Power cable

- Asynchronous type Smart card (Synchronous cards are not supported since C4/C8 do not exist)
- Digital voltmeter
- 4 channels (Bw > 200 MHz) digital oscilloscope

#### System Power Up

Adjust your power supply output at 9 V (if a current limit circuit is present, set it at 500 mA).

You must find in the package a power cable with 3.5 mm coax connector. With polarity respect, plug the two wires extremities into the lab power supply.

Double check with a DVM if the voltage and polarity are correct at the coaxial connector:

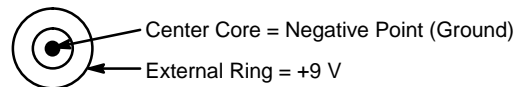


Figure 1.

Make sure the S1 dip switch configuration is as depicted here below to force the micro controller operation in the single chip mode:

N#1 = ON

N#2, 3, 4 = OFF

At this point you can plug the coax connector into J100, then press the RESET button. The initialization sequence is performed, the LED's diodes being activated accordingly. The system is preset as follow:

If no card was inserted prior to power up the system:

+5 V Power	ON	Green LED, power supply connected to the board.
CRD_VCC	3.0 V	Green LED.
CRD_DET	NO	Red LED, normally open switch. <b><i>This mode must not be changed.</i></b>
CRD_CLK	1/1	Yellow LED, clock divider ratio = 1/1.
VbatOK	ON	Green LED, must be ON if the power supply is correct.
DC_Over	ON	Red LED, the DC/DC is <b>OFF</b> .

If a card was inserted prior to turn on the power supply:

+5 V Power	ON	Green LED, power supply connected to the board.
CRD_VCC	3.0 V	Green LED.
CRD_DET	NO	Red LED, normally open switch. <b><i>This mode must not be changed.</i></b>
CRD_CLK	1/1	Yellow LED, clock divider ratio = 1/1.
VbatOK	ON	Green LED, must be ON if the power supply is correct.
DC_Over	ON	Red LED, the DC/DC is <b>OFF</b> .
CRD_IN	ON	Green LED, a card is inserted.

In both case, the demo board comes with the CLK\_IN signal connected to the built in 8 MHz crystal. This clock can be changed as depicted in the Card Power On Measurements section.

### Host Connections

Communications from the host computer are carried out by means of the standard RS232 serial port. The PC shall be connected to the demo board by a nine pins, Sub-D Female/Female cable. Provisions are made with S100 and S101 to exchange lines 2 and 3 to cope with different type of cable used to connect the system. The demo board is supplied with direct pin to pin connection .

The data are transferred through the serial port according to the here below format:

Speed	9600 bauds
Number of Bits	8
Start Bit	1
Stop Bit	1
Parity	None

The card emulator software provided with the demo board set up the PC to handle these parameters properly. Using different software or terminal may need a serial port parameters adjustment.

### Demo Board Overview

The demo board is built on a dual side, metal though holes, printed circuit board. Provision are made to get an easy access to the key parameters during the evaluation of this integrated circuit. The top view is given in Figure 2.

### Default Set Up After a VBAT Power ON, or RESET Action

When the board is powered up, the built-in functions of the NCN6000 set the default configuration as follow:

CARD VCC = 3 V  
 CARD DETECTION = Normally Open  
 CARD CLOCK divided by 1 and Running\*  
**CARD POWER = OFF**

\*CRD\_IO, CRD\_RST, CRD\_CLK pins stay Low, until the card power is turned on (see product data sheet).

NOTE: Any action on the RESET push button forces the MCU to send this configuration to the NCN6000, avoiding any miss match with the software saved in memory.

If nothing goes wrong, the LEDs should display the same set up, together with the actual NCN6000 STATUS result (VBAT and DC\_OVER LEDs are ON). When the NCN6000 DC/DC converter is off, the DC\_OVER bit in the status register is set high since no voltage is developed across the CRD\_VCC pin.

### Card Power On and Measurements

Connect the oscilloscope probes to CRD\_RST, CRD\_CLK, and CRD\_IO. Use GROUND points as reference. Set up these three scope inputs at DC 5 V/div vertical scale and 100  $\mu$ s time base.

Connect the fourth probe to low noise card CRD\_VCC red test point near C5. A short ground connection is required. Set this channel at 1 V DC/div on your oscilloscope.

NOTE: When measuring ripple voltage, make sure to use a single Ground point for the four probes, or use the CRD\_VCC probe only.

To turn on the CRD\_VCC voltage (thus, to run the internal DC/DC), a smart card must be inserted. The card insertion yields an interrupt. The MPU acknowledges this signal and reads the STATUS bits, turning ON the CRD\_IN LED diode. The Pwr\_ON key can now be used to activate the CRD\_VCC output.

NOTE: When no card is available during the NCN6000 evaluation, one can set up the CRD\_DET as a Normally Close switch, making possible the DC/DC operation when no card is inserted (see NO/NC key). This engineering mode is possible since the demo board is built with a Normally Open switch mechanism, thus yielding a High level when no card is inserted. *However, such a mode must be avoided when a real card is inserted since the system will not operate when the mechanical switch is activated, thus forcing the CRD\_DET pin to Low. In any doubt, reset the system an run a new set of measurements.*

At this point, one can program the demo board operating conditions to visualize the behavior of the NCN6000. The key board reflects the data sheet functions and is used as an input device to select the operating conditions. The LED's are updated according to the conditions defined by the user.

The input clock (CLK\_IN) can be derived from either the built-in crystal (pre wired mode), or connected to an external periodic signal, to generate the CRD\_CLK. The selection is achieved by means of the JP1 CLK\_Select jumper according to Table 1 below.

**Table 1. Clock Selection**

Set CLK_Select jumper to the right	→ Use the built-in crystal (default position)
Set CLK_Select jumper to the left	→ Use the signal provided to the P1 Ext_Clk_In SMA connector.

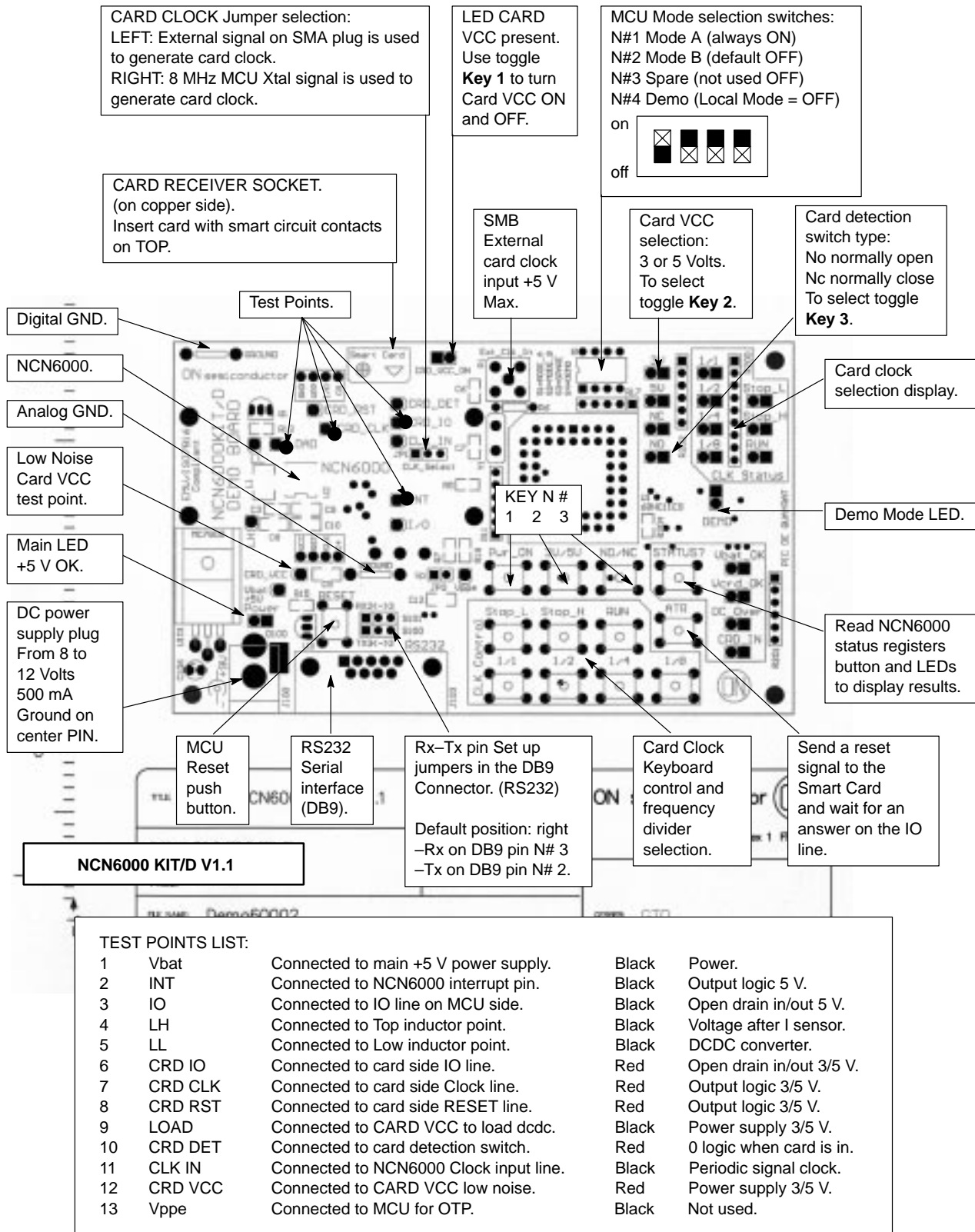


Figure 2. NCN6000 Demo Board Layout

Set up the external clock source to generate a 5 V peak to peak positive going signal, with appropriate frequency, making sure no over shoot are developed at the clock input. The NCN6000 can accommodate 40 MHz input clock, but the clock divider must be adjusted to cope with the smart card (maximum ISO7816-3 operating clock is 20 MHz, EMV document specifies a 1 to 5 MHz range for banking applications).

When using an external clock, the MCU card reading routines, and ATR time outs, are not available.

### Oscilloscopes and Waveforms

During the CRD\_VCC rise time, all the smart card related logic lines are Low, avoiding the risk of uncontrolled data transaction with the card. When the voltage reaches the minimum programmed value, the lines are activated, according to the normalized ISO7816-3 sequence, as depicted Figure 3. The logic levels present on these lines are the one defined by the micro controller and can be either 1's or 0's.

Since no transaction can occur when CRD\_VCC is below the minimum value, it is the engineer's responsibility to make sure the system is active prior to launch any smart card command. Such a check can be achieved by either reading the STATUS bit (preferred), or by forcing a 2 ms delay before to activate the card.

The power down sequence takes place when either a card is extracted, or when a fault is developed in the interface. In any case, the NCN6000 runs the ISO7816-3 normalized sequence as recorded Figure 4.

The TOP trace of Figure 5 represents the voltage across the internal NMOS, the BOTTOM trace being the CRD\_VCC ripple.

Measuring the CRD\_VCC ripple needs a lot of cares to make sure the waveforms represent the right parameter. A couple of dedicated test points are provided on the NCN6000 demo board for such purpose: CRD\_VCC and GROUND located on each side of capacitor C5. One single ground point must be used to carry out this test. As already depicted in the data sheet, using standard electrolytic or tantalum capacitor will downgrade the ripple, making the system more sensitive to EMV/ISO possible non qualification. The demo board comes with three X5R ceramic capacitors from Murata (C9, C10 and C5) in parallel. However, a final product can be designed with either a single 10 $\mu$ F or two 4.7 $\mu$ F capacitors to save system cost, depending upon the PCB lay out and wiring. A good technique is to split the CRD\_VCC reservoir capacitor in two component, one being located as close as possible to the NCN6000 pins, the second being wired across the smart card ISO connector.

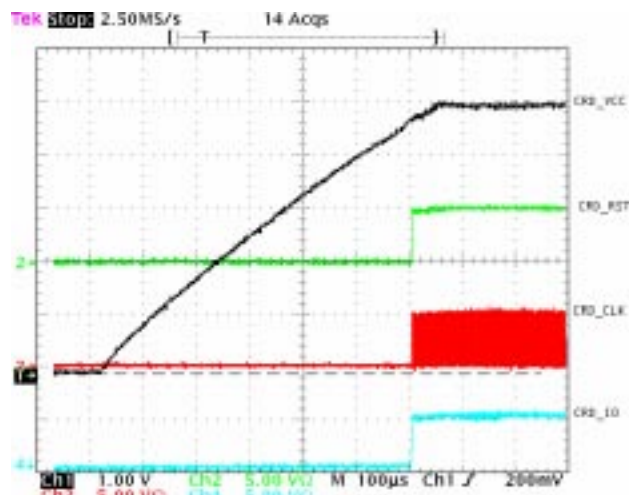


Figure 3. Power ON Sequence

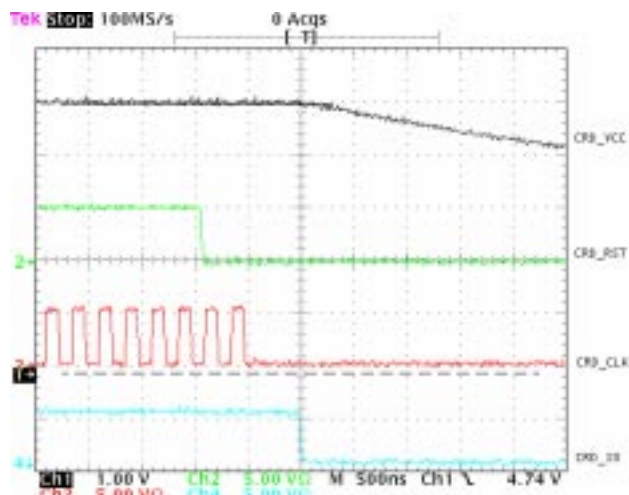
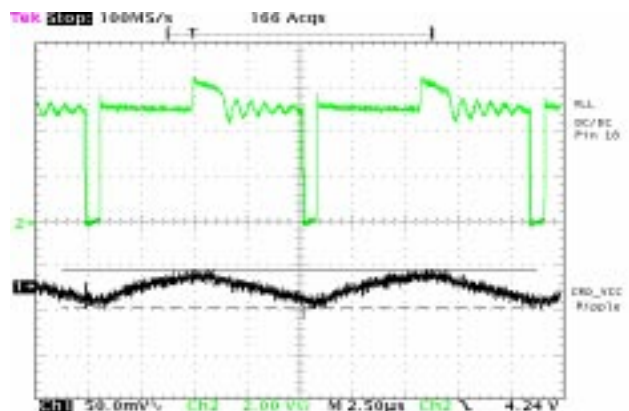


Figure 4. Power Down Sequence



Rload = 100  $\Omega$ , Vbat = 5 V, CRD\_VCC = 5.0 V,  
Cout = 10  $\mu$ F, CRD\_CLK = Stop High

Figure 5. CRD\_VCC Voltage Ripple



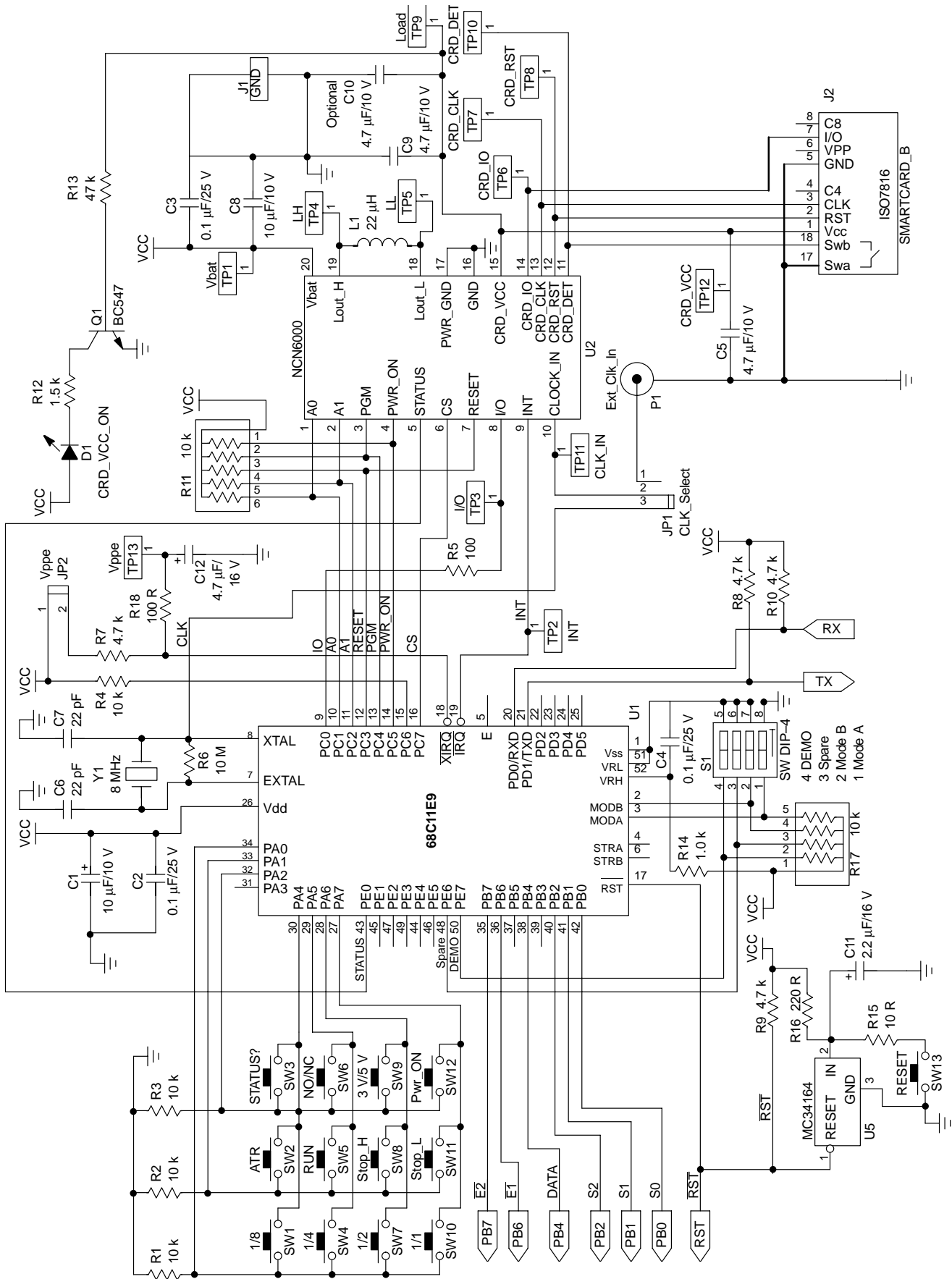


Figure 6. Micro Controller and Key Board Schematic Diagram

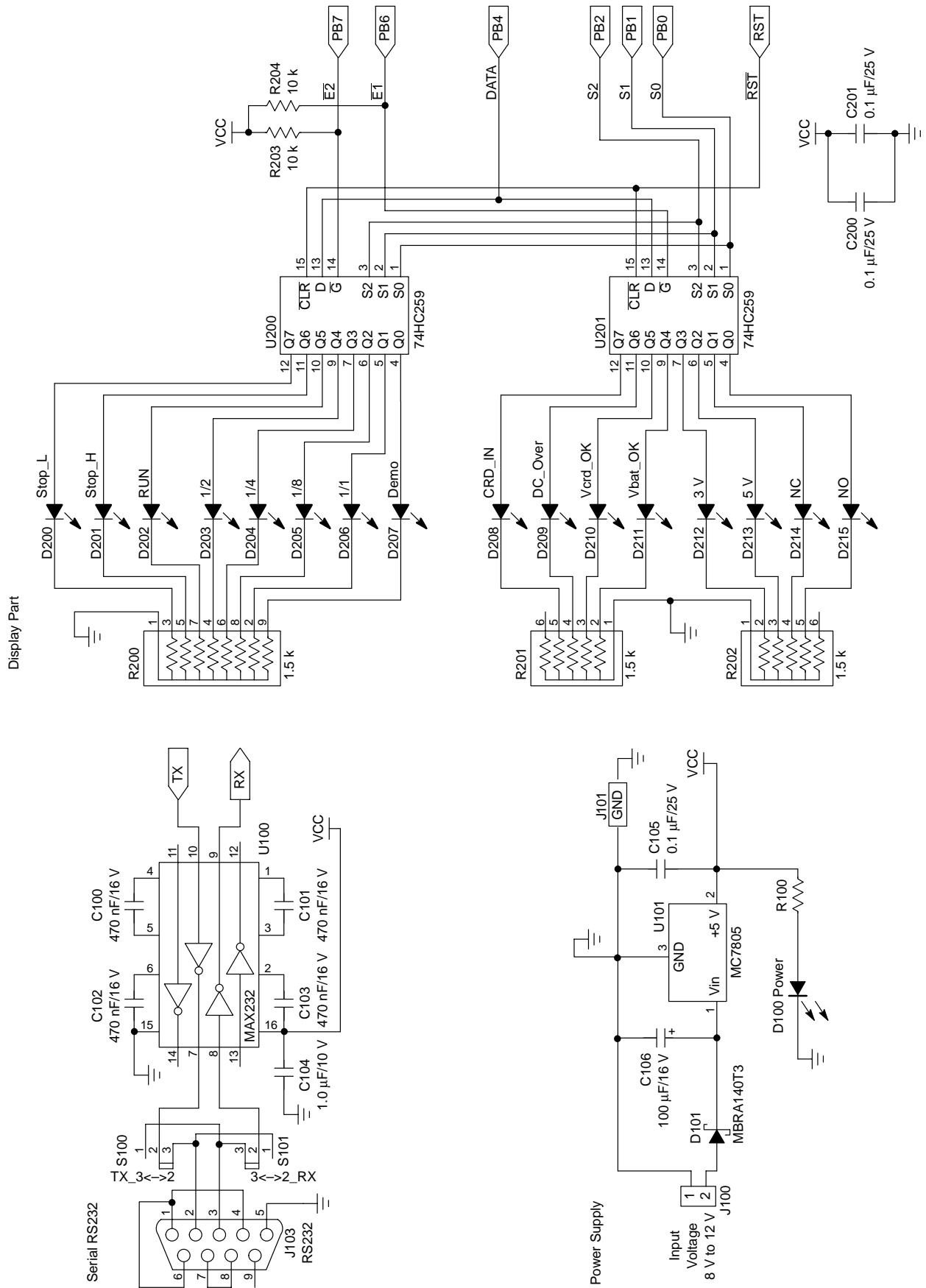


Figure 7. Display, Power Supply and Serial Interface Schematics

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## BILL OF MATERIALS

Part	Designator	Footprint	Description	Preferred Supplier	P/N
<b>Converter</b>					
C1	10 $\mu$ F/10 V	1206	Capacitor Tantalum	–	–
C2	0.1 $\mu$ F/25 V	805	Capacitor X7R	MURATA	GRM40X7R104K25
C3	0.1 $\mu$ F/25 V	805	Capacitor X7R	MURATA	GRM40X7R104K25
C4	0.1 $\mu$ F/25 V	805	Capacitor X7R	MURATA	GRM40X7R104K25
C5	4.7 $\mu$ F/10 V	1206	Capacitor X5R	MURATA	GRM426X5R475Z10
C6	22 pF	805	Capacitor COG	MURATA	GRM40COG220J50
C7	22 pF	805	Capacitor COG	MURATA	GRM40COG220J50
C8	10 $\mu$ F/10 V	1206	Capacitor Y5V	MURATA	GRM230Y5V106Z10
C9	4.7 $\mu$ F/10 V	1206	Capacitor X5R	MURATA	GRM426X5R475Z10
C10	4.7 $\mu$ F/10 V (Optional)	1206	Capacitor X5R	MURATA	GRM426X5R475Z10
C11	2.2 $\mu$ F/16 V	1206	Capacitor Tantalum	–	–
C12	4.7 $\mu$ F/16 V	1206	Capacitor Tantalum	–	–
C100	470 nF/16 V	805	Capacitor Y5V	–	–
C101	470 nF/16 V	805	Capacitor Y5V	–	–
C102	470 nF/16 V	805	Capacitor Y5V	–	–
C103	470 nF/16 V	805	Capacitor Y5V	–	–
C104	1.0 $\mu$ F/16 V	805	Capacitor Y5V	MURATA	GRM40Y5V105Z16D530
C105	0.1 $\mu$ F/25 V	805	Capacitor X7R	MURATA	GRM40X7R104K25
C106	100 $\mu$ F/16 V	Radial	Capacitor Electrolytic	–	–
C200	0.1 $\mu$ F/25 V	805	Capacitor X7R	MURATA	GRM40X7R104K25
C201	0.1 $\mu$ F/25 V	805	Capacitor X7R	MURATA	GRM40X7R104K25
D1	CRD_VCC_ON	SIP2	LED Diode Red Rectangle $I_F = 20$ mA	Generic	–
D100	Power	SIP2	LED Diode Green Rectangle $I_F = 20$ mA	Generic	–
D101	MBRA140T3	SMB/P4.5	Schottky Diode 1.0 A, 40 V	ON Semiconductor	MBRA140T3
D200	Stop_L	SIP2	LED Diode Red $I_F = 2.0$ mA/round 3.0 mm	Generic	–
D201	Stop_H	SIP2	LED Diode Red $I_F = 2.0$ mA/round 3.0 mm	Generic	–
D202	RUN	SIP2	LED Diode Green $I_F = 2.0$ mA/round 3.0 mm	Generic	–
D203	1/2	SIP2	LED Diode Yellow $I_F = 2.0$ mA/round 3.0 mm	Generic	–
D204	1/4	SIP2	LED Diode Yellow $I_F = 2.0$ mA/round 3.0 mm	Generic	–
D205	1/8	SIP2	LED Diode Yellow $I_F = 2.0$ mA/round 3.0 mm	Generic	–
D206	1/1	SIP2	LED Diode Yellow $I_F = 2.0$ mA/round 3.0 mm	Generic	–
D207	Demo	SIP2	LED Diode Red $I_F = 2.0$ mA/round 3.0 mm	Generic	–

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## BILL OF MATERIALS (continued)

Part	Designator	Footprint	Description	Preferred Supplier	P/N
<b>Converter</b>					
D208	CRD_IN	SIP2	LED Diode Green I <sub>F</sub> = 2.0 mA/round 3.0 mm	Generic	—
D209	DC_Over	SIP2	LED Diode Red I <sub>F</sub> = 2.0 mA/round 3.0 mm	Generic	—
D210	Vcrd_OK	SIP2	LED Diode Green I <sub>F</sub> = 2.0 mA/round 3.0 mm	Generic	—
D211	Vbat_OK	SIP2	LED Diode Green I <sub>F</sub> = 2.0 mA/round 3.0 mm	Generic	—
D212	3.0 V	SIP2	LED Diode Green I <sub>F</sub> = 2.0 mA/round 3.0 mm	Generic	—
D213	5.0 V	SIP2	LED Diode Red I <sub>F</sub> = 2.0 mA/round 3.0 mm	Generic	—
D214	NC	SIP2	LED Diode Green I <sub>F</sub> = 2.0 mA/round 3.0 mm	Generic	—
D215	NO	SIP2	LED Diode Red I <sub>F</sub> = 2.0 mA/round 3.0 mm	Generic	—
L1	22 µH	1812	200 mA/1.2 Ohms	MURATA	—
J1	GROUND	GND_TEST	—	—	—
J100	POWER SUPPLY	PLUG_25_BAT	—	Generic	—
J101	GROUND	GND_TEST	—	MC	—
J103	RS232	DB9RA/M	—	—	—
J2	SMARTCARD_B	—	SMARTCARD_ISO	—	—
P1	Ext_Clk_In	SMB	—	—	—
R1	10 k	805	—	Generic	—
R2	10 k	805	—	Generic	—
R3	10 k	805	—	Generic	—
R4	10 k	805	—	Generic	—
R5	1.2 k	805	—	Generic	—
R6	10 M	Axial0.3	—	Generic	—
R7	4.7 k	805	—	Generic	—
R8	4.7 k	805	—	Generic	—
R9	4.7 k	805	—	Generic	—
R10	4.7 k	805	—	Generic	—
R11	10 k	SIP6	—	Generic	—
R12	1.5 k	805	—	Generic	—
R13	47 k	805	—	Generic	—
R14	1.0 k	805	—	Generic	—
R15	10 R	805	—	Generic	—
R16	220 R	805	—	Generic	—
R17	10 k	SIP5	—	Generic	—
R18	100 R	805	—	Generic	—
R100	1.0 k	805	—	Generic	—



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## BILL OF MATERIALS (continued)

Part	Designator	Footprint	Description	Preferred Supplier	P/N
<b>Converter</b>					
R200	1.5 k	SIP9	–	Generic	–
R201	1.5 k	SIP6	–	Generic	–
R202	1.5 k	SIP6	–	Generic	–
R203	10 k	805	–	Generic	–
R204	10 k	805	–	Generic	–
S1	SW DIP–4	DIP8	–	Generic	–
S100	TX_3<--> 2	SIP3	–	–	–
S101	3<-->2_RX	SIP3	–	–	–
JP1	CLK_Select	SIP3	50 CONTACTS AMP5 – 826629–0 →	Generic	–
JP2	Vp	SIP2	Green Jumper AMP →	Generic	–
Q1	BC547	TO92L	–	ON Semiconductor	BC547B
U1	68HC711E9	PLCC52	–	Motorola	–
U2	NCN6000	TSSOP20	–	ON Semiconductor	NCN6000DTB
U3	MC34164	TO92L	–	ON Semiconductor	MC34164D–5
U100	MAX232	SO–16	–	Generic	–
U101	MC7805	TO–220V	–	ON Semiconductor	MC7805–2CT
U200	74HC259	SO–16	–	ON Semiconductor	MC74LVX259D
U201	74HC259	SO–16	–	ON Semiconductor	MC74LVX259D
Y1	8.0 MHz	XTAL2	–	Generic	–
TP1	Vbat	TEST_PT	2,54 Black TEST_POINT	Generic	–
TP10	CRD_DET	TEST_PT	2,54 Red TEST_POINT	Generic	–
TP11	CLK_IN	TEST_PT	2,54 Black TEST_POINT	Generic	–
TP12	CRD_VCC	TEST_PT	2,54 Red TEST_POINT	Generic	–
TP13	Vppe	TEST_PT	2,54 Black TEST_POINT	Generic	–
TP2	INT	TEST_PT	2,54 Black TEST_POINT	Generic	–
TP3	I/O_IN	TEST_PT	2,54 Black TEST_POINT	Generic	–
TP4	LH	TEST_PT	2,54 Black TEST_POINT	Generic	–
TP5	LL	TEST_PT	2,54 Black TEST_POINT	Generic	–
TP6	CRD_IO	TEST_PT	2,54 Red TEST_POINT	Generic	–
TP7	CRD_CLK	TEST_PT	2,54 Red TEST_POINT	Generic	–
TP8	CRD_RST	TEST_PT	2,54 Red TEST_POINT	Generic	–
TP9	LOAD	TEST_PT	2,54 Black TEST_POINT	Generic	–
SW1	1/8	PUSH_BUT	PB std Black ALPS	Generic	–
SW2	ATR	PUSH_BUT	PB std Red ALPS	Generic	–
SW3	STATUS?	PUSH_BUT	PB std Black ALPS	Generic	–
SW4	1/4	PUSH_BUT	PB std Black ALPS	Generic	–
SW5	RUN	PUSH_BUT	PB std Black ALPS	Generic	–
SW6	NO/NC	PUSH_BUT	PB std Grey ALPS	Generic	–

**BILL OF MATERIALS (continued)**

Part	Designator	Footprint	Description	Preferred Supplier	P/N
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**Converter**

SW7	1/2	PUSH_BUT	PB std Black ALPS	Generic	–
SW8	Stop_H	PUSH_BUT	PB std Black ALPS	Generic	–
SW9	3.0 V/5.0 V	PUSH_BUT	PB std Grey ALPS	Generic	–
SW10	1/1	PUSH_BUT	PB std Black ALPS	Generic	–
SW11	Stop_L	PUSH_BUT	PB std Black ALPS	Generic	–
SW12	Pwr_ON	PUSH_BUT	PB std Red ALPS	Generic	–
SW13	RESET	PUSH_BUT	PB std Red ALPS	Generic	–

**Miscellaneous**

Heatsink TO–220	KL10SWV
Through Hole PLCC52 Socket	FCI
3 Spacers Hexagonal 0.8 mm M3	–
3 Screws M3 L 6 mm	–
3 Fiber Rings M3	–
Banana Plug 4 mm (Red)	–
Banana Plug 4 mm (Black)	–
Plug Power 2.5 mm/1 A	–
Power Cable 2 × 0.5 mm <sup>2</sup> Black 1 Meter	–

**NCN6000/KIT/D SOFTWARE**

The software, available free from ON semiconductor, provides a simple way to program the NCN6000 parameters and to read/write the external smart card. The built-in code handles the T0 protocol, the T1 being not included yet in the EPROM.

**Program Set Up**

NOTE: The software operates on WINDOWS / NT4 based machine, DOS system is not suitable for this application.

Minimum RAM: 64 Mo

Minimum Hard disk space: 10 Mo

- Download the files from the ON semiconductor CD. There are four files and one folder to save in your hard disk:
  - Support Folder, contains .ddl update
  - NCN6000\_COM\_1 file
  - NCN6000\_COM\_2 file
  - Setup.exe Set up executable file
  - Setup.lst Set up file
- Launch the Setup.exe program. The system will automatically unpack the files and prepare your computer to run the software.
- Start the NCN6000\_DEMO.exe program . A single window will be opened on your screen, all

the command being performed though the menu and buttons presents in this screen.

- Make sure the Serial Port COM1 is free prior to open the port from the window.** Connect the serial port cable to the demo board, set the system in the Remote Mode (see SYSTEM OPERATING MODE\*), power up the board, open the RS232 port and hit SEND ATR. Assuming a card is inserted, the system will launch an ATR, the data being displayed in the bottom window. The data can be decoded by pushing the Decode Data button on the right Hand side of the screen.

\*The demo board is delivered preset in the Local Mode.

**System Operating Mode**

The demo board can operates in either of the three available modes:

- LOCAL MODE:** set S1 Dip Switch as depicted here below:
  - N#1 = ON Select MPU single chip mode: do not change.
  - N#2 = OFF Select MPU single chip mode: do not change.
  - N#3 = OFF Not affected.
  - N#4 = OFF Select System Local mode.

Push the RESET button (bottom, left hand side above the RS232 connector ) to re-initialize the system.

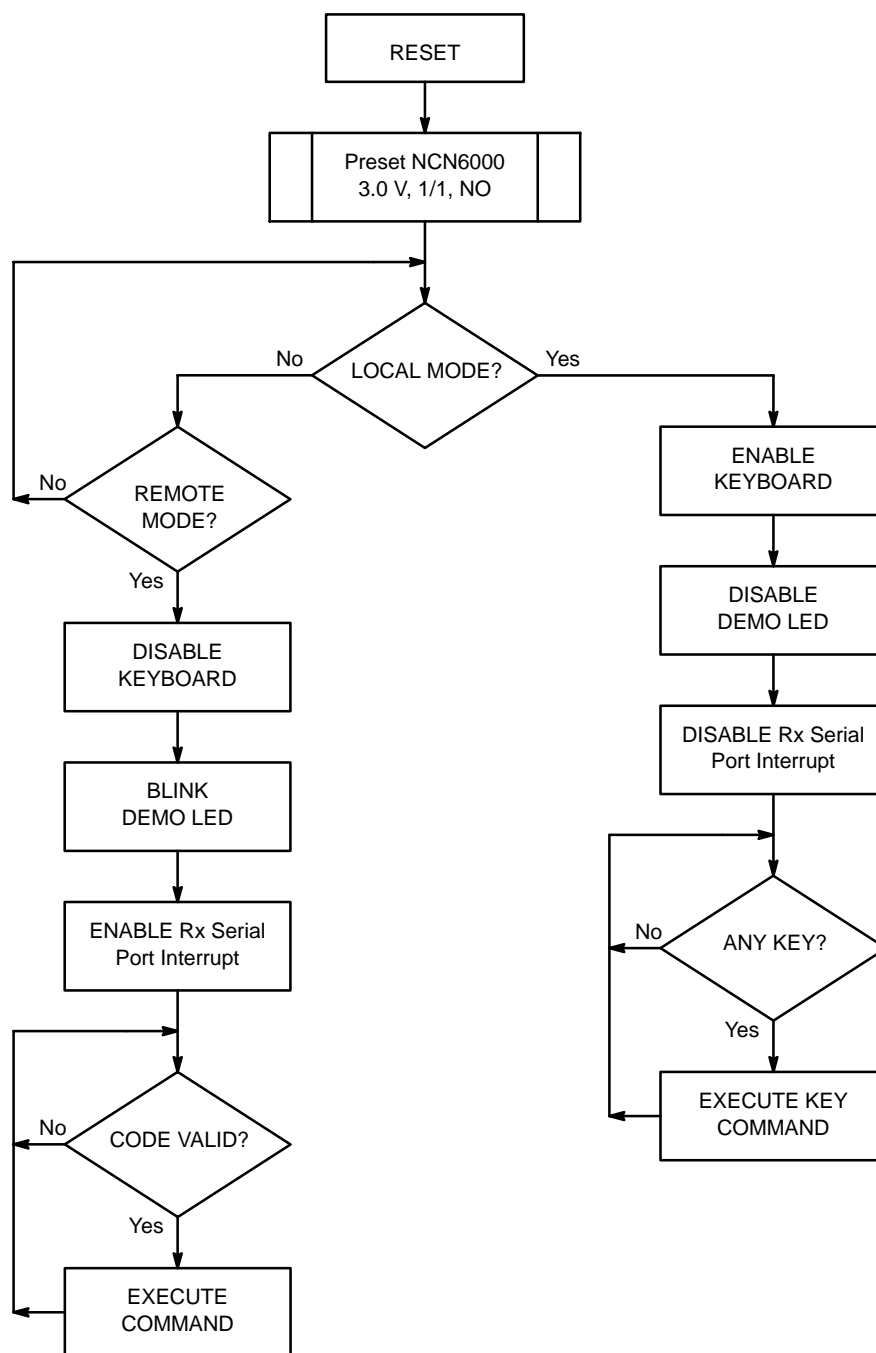


Figure 8. Basic Program Flowchart

All the commands are under the keyboard control. The interface can be set up to cope with the smart card specifications. All the data transferred from the smart card are forwarded to the external PC by means of the serial port. However, the system neither check the data, nor wait for feedback from the host computer and it is not necessary to connect the port to run the system. All the signals can be monitored, thanks to the test points provided on the PCB.

As depicted in the NCN6000 data sheet, a card must be inserted to activate the DC/DC converter. However, all the parameters can be pre-programmed without any card

inserted and will be activated at the next card insertion (excepted Card VCC selection = 3 V, and Power is OFF after each card extraction).

2. **REMOTE MODE:** set S1 Dip Switch as depicted here below :

- N#1 = ON Select MPU single chip mode: do not change.
- N#2 = OFF Select MPU single chip mode: do not change.
- N#3 = OFF Not affected.
- N#4 = ON Select System Remote mode.

Push the RESET button (bottom, left hand side above the RS232 connector) to re-initialize the system. The DEMO LED shall blink to identify the operating mode.

Connect the serial port cable, make sure the serial port COM1 is free from any other usage, make sure the RS232 is properly set up, open the serial port by either a menu command, or by a click in the OPEN RS232 button (close by the red LED on the right hand side of the screen). This button is a flip-flop to Open/Close the port.

The keyboard is deactivated and all the commands must be performed by the external host computer. All the data transferred from the smart card are forwarded to the external PC by means of the serial port. However, the system neither check, nor wait for feedback from the host computer.

The NCN6000\_COM1 software provides a full control of the operation, including the T0 decoding of the data coming from an ATR command. The T1 protocol is not supported by this version of the software.

The NCN6000 PROGRAMMING area located on the top left hand side of the screen is used to program the chip. Although the CS status is not directly transferred to the NCN6000, it must be set to Low to activate the rest of the commands.

According to the device's data sheet, the CRD\_VCC voltage can be adjusted to either 3.0 V or 5.0 V when PGM is High.

When PGM = Low, the other parameters can be programmed according to a specific card.

**NOTE:** Although it is possible to change the CRD\_DET from Normally Open to Normally Close, doing so will generate a reverse operation of the system since the physical card detection switch is hard wired as a NO device. It is strongly recommended to avoid such a change as power will be applied to the ISO contacts when the card is not inserted.

The selected parameter is updated immediately after a click in the related button.

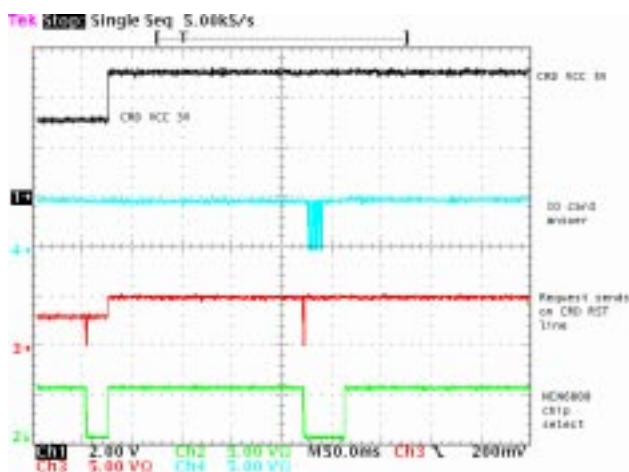


Figure 9. Card Answer to an ATR Request in REMOTE MODE

A click in the STATUS button activates a read of the NCN6000, the screen being updated accordingly.

A click in the SEND ATR button activates an ATR sequence, the result being displayed in the DATA FROM CARD window. If the Auto Clear box is checked, the window is cleared and the previous data are lost. When a data string is present in this window, a push on the Decode Card button will update the T0 to TCK labels with the data decoded from the ATR answer. If no card was inserted, or if the ATR failed, the system returns the "NO\_Card\_Answer" comment.

**NOTE:** After a "SEND ATR" request, the MCU turns Card Vcc ON automatically, then if the card doesn't answer at CRD\_VCC = 3 V within the specified time out ( 40000 Card Clock Cycles ), the MCU switches the DC/DC to 5 V then send a new ATR command. The demo board embedded software does not try other clock division ratio than the one pre programmed by the user.

Obviously, the IO answer strongly depends upon the smart card content.

The MCU software recognizes two card communication protocols (\$ symbol stands for Hexadecimal values):

1. \$3B = LSB First, IO pin is pulled down to code logical 0
2. \$3F = MSB First, IO pin is pulled down to code logical 1

The first byte sent by the card after an ATR defines the card protocol. The MCU keeps this data in memory to format correctly the card commands. The message "Unknown Protocol" could be displayed after an ATR if:

- The card protocol is not compatible with \$3B or \$3F codes.
- The card VCC selection is inappropriate.
- The card clock is too high, or generated by an external source.

After each card insertion, or MCU reset, you have to run one ATR to define the protocol. Then you will be able to communicate with the card by using SEND COMMAND.

A click in the SEND COMMAND button will run a write sequence to the card inserted in the demo board socket.

The parameters are the one defined with the five bytes manually updated in the header fields located on the right of the DATA FROM CARD window. The reply from the card will be displayed in this window.

### 3. MPU EPROM/EEPROM Programming: set S1

Dip Switch as depicted here below :

- N#1 = ON Select MPU Download S1S9 file.
- N#2 = ON Select MPU Download S1S9 file.
- N#3 = OFF Not affected.
- N#4 = OFF Not affected.

In this mode, the memory of the embedded micro controller can be updated with a new software through the

serial port, using either the RAM or EPROM built inside the MC68HC711E9 micro controller.

**NOTE:** Since uncontrolled operation might occurs if this mode is activated, cares must be observed before to flip S1 into this state. During normal operations of the demo board, using this mode is NOT necessary, unless you intentionally want to download a customized software.

A specific software, not included in the kit, is necessary to down load a new code into the micro controller. When the new code is routed to the EPROM, jumper JP2 shall be removed and a 12.5 V DC voltage power supply connected to the left pin to active the micro controller built-in routines: see the Motorola MC68HC711E9 data sheet for the programming details.

**NOTE:** It is not possible to erase the program stored into the internal EPROM of the standard plastic package supplied with this demo board. A new fresh MC68HC711E9, or MC68HC811E9 micro controller chip must be inserted to support any new software development.

## NCN6000/KIT/D Commands

The NCN6000 control software provided with the demo board takes care of all the commands necessities to handle the transaction with the card. All the commands are listed in Table 2 (Hexadecimal format) and can be use to interface the kit with a customized software.

Assuming you have a micro controller emulator available, you can replace the MC68HC711E9 by the logic probe and run you own software, the hardware being kept constant.

Examples (mnemonics are based on the Motorola HC11 set of instructions):

Set the NCN6000 clock divider 1/2 and CRD\_VCC = 5.0 V:

```
LDAA  #$03
JSR   send_byte ;this sub routine send the byte to the
                    RS232 port
```

```
LDAA  #$01
JSR   send_byte
```

Send a command to the card:

```
LDAA  #$A0
JSR   send_byte ;send the Header Class identifier
LDAA  #$00
JSR   send_byte ;send the code
```

**Table 2. NCN6000/KIT/D Commands and Functions**

CMD	Description	Format
\$00	Card VCC = 3.0 V	1 byte
\$01	Card VCC = 5.0 V	1 byte
\$02	CRD_CLK Divided 1/1	1 byte
\$03	CRD_CLK Divided 1/2	1 byte
\$04	CRD_CLK Divided 1/4	1 byte
\$05	CRD_CLK Divided 1/8	1 byte
\$06	CRD_CLK Run	1 byte
\$07	CRD_CLK Stop Low	1 byte
\$08	CRD_CLK Stop High	1 byte
\$09	CRD_DET Detection Switch Normally Open	1 byte
\$0A	CRD_DET Detection Switch Normally Close	1 byte
\$0B	Read STATUS Bits	1 byte
\$0C	CRD_VCC Power ON	1 byte
\$0D	CRD_VCC Power OFF	1 byte
\$0E	Send ATR to Card	1 byte
\$90	Send Command to Card	1 byte
\$A0	Following Byte Is the Header Class	2 bytes: \$A0HH
\$B0	Following Byte Is the Header Instruction	2 bytes: \$B0HH
\$C0	Following Byte Is the Header Address High	2 bytes: \$C0HH
\$D0	Following Byte Is the Header Address Low	2 bytes: \$D0HH
\$E0	Following Byte Is the Header Number of Bytes to Read from Card	2 bytes: \$E0HH
\$F0	Following Byte Is the Extra Guard Time Requested by the Card	2 bytes: \$F0HH

NOTES: HH represents the Hexadecimal code defined by the card used.


All other hexadecimal codes not depicted in this table (CMD) are reserved for future use.

**References**

- ISO/IEC 7816–3 International Standard, revision.
- ISO/IEC 7816–4 International Standard, revision.
- GSM11.11, version 7.3.0 – 1998, ETSI.
- EMV Terminal Specifications For Payment Systems,  
Europay MasterCard Visa.
- NCN6000 qualified data sheet, ON Semiconductor.



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