



advanced card systems ltd



AC1020 & AC2001

ACS Microcontroller Unit

Technical Data Sheet

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AC1020, AC2001

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1. INTRODUCTION

The AC-Set Chipset (AC1020 and AC2001) is a 2 chips solution. It acts as an interface for the communication between a host computer (for example, a PC) and a smart card.

Different types of smart cards have different commands and different communication protocols. This prevents in most cases the direct communication between a smart card and a computer. The AC-Set establishes a uniform interface from the host computer to the smart card for a wide variety of cards. By taking care of the electrical interface, communication protocol handling and the card specific particulars, it releases the computer software programmer of getting involved with the technical details of the smart card operation, which are in many cases not relevant for the implementation of a smart card system.

The AC-Set chipset is connected to the host computer through a serial asynchronous interface. The AC1020 accepts commands from the computer, carries out the specified function at the smart card and returns the requested data or status information. The AC2001 provides a flexible interface to different smartcards according to ISO 7816 standard.

2. FEATURES

- ISO7816-1/2/3 compatible smart card interface
- Supports most common memory-based smart cards (2-wire bus, 3-wire bus)
- Supports CPU-based cards with T=0 and/or T=1 protocol
- 3.68MHz CLK frequency for microcontroller-based cards
- Supports PTS (protocol type selection) procedure
- Automatic detection memory-based card or microcontroller-based card
- Smart card interface short circuit protected
- Power up/down sequence compatible to ISO7816 for signal integrity
- Automatic detection of card insertion and removal
- Serial interface to host computer with simple command structure
- Selectable baudrate of serial interface to host system, max. 115 Kbit/s

- ❑ 44-Pin Quad Flat Pack (QFP for AC1020)
- ❑ 24-Pin SOIC or 24-Pin TSSOP for AC2001
- ❑ Operating temperature range: 0°C to 70°C (AC1020), -25°C to +85°C (AC2001)
- ❑ Power supply at 5V±10%

3. Applications

- ❑ PC keyboard
- ❑ Pay TV
- ❑ Personal computer
- ❑ Network computer
- ❑ PC peripheral device
- ❑ Vending machine
- ❑ Payphone
- ❑ Terminals
- ❑ PDA
- ❑ ATM
- ❑ Loyalty

4. AC1020 (in AC-Set) Pin Assignments

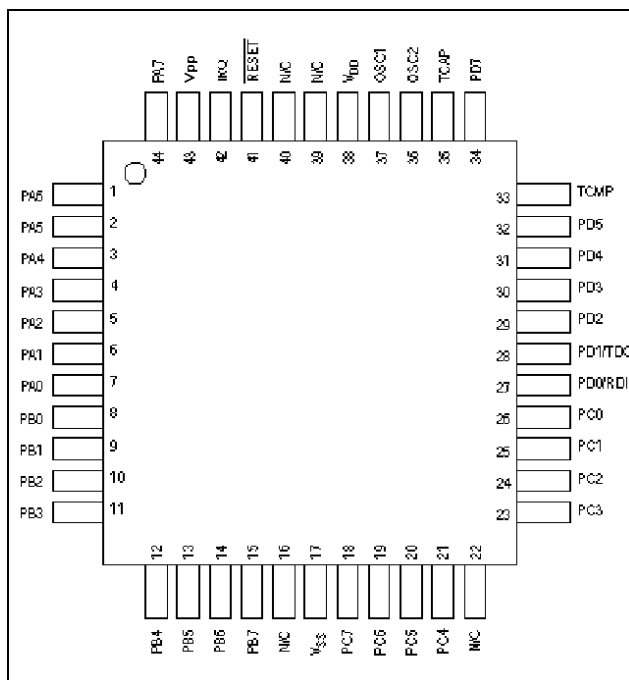


Figure 1. 44-Pin QFP Pin Assignments

Note: Pin 43 is V_{PP} and should be connected to V_{DD} , Pin 38.

5. Pin Function Description (AC1020)

Name	Description
V _{DD}	Power Supply
V _{SS}	Ground
V _{PP}	Pin 43 to be connected to V _{DD}
OSC1, OSC2	Control connections for the on-chip oscillator
/RESET	A logic zero on the RESET pin forces AC1020 to a known start-up state.
/IRQ	External interrupt, connects to pin 3 of AC2001
TCMP	Timer compare pin, not used in this application
TCAP	Timer capture pin, connects to PC4
PA0-7	Input / Output Port A, not used in this application
PB0-7	Input / Output Port B, PB0-2 are not used. PB3 is REQ pin for serial data transfer, requires a 10K pull up. PB4 controls the power LED PB5 connects to C6(Vpp) of the smartcard connector PB6 supplies the synchronous clock signal to AC2001 PB7 is the Clear-to-send (CTS) output to the host computer
PC0-7	Input / Output Port C, PC0 to PC7 are connected to AC2001 to control the smartcard interface.
PD0-7	PD0/RDI receives serial data from host PD1/TDO transmits serial data to host PD4,PD5 is input port to set the default data rate between host and AC1020 PD2,PD3 and PD7 are not used in this application

6. Maximum Ratings (AC1020)

AC1020 contains circuitry that protects the inputs against damage from high static voltages; however, do not apply voltages higher than those specified in the table below. Keep Vin and Vout within the range $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$.

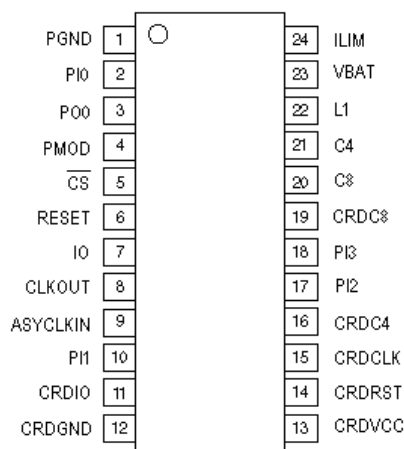
Rating	Symbol	Value	Unit
Input Voltage All Pins in Normal Operation	V _{DD}	-0.3 to +7.0	V
Current Drain Per Pin (Excluding V _{DD} and V _{SS})	I	25	mA
Operating Temperature Range	T _A	T _L to T _H 0 to +70	°C
Storage Temperature Range	T _{STG}	-65 to +150	°C

7. DC Electrical Characteristics ($V_{DD} = 5.0 \text{ Vdc}$) (AC1020)

($V_{DD} = 5.0 \text{ Vdc} \pm 10\%$, $V_{SS} = 0 \text{ Vdc}$, $T_A = T_L$ to T_H , unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage, $I_{LOAD} \leq 10.0 \mu\text{A}$	V_{OL}	-	-	0.1	V
	V_{OH}	$V_{DD}-0.1$	-	-	V
Output High Voltage ($I_{LOAD} = 0.8\text{mA}$) Port A,,B,C,D,TCMP	V_{OH}	$V_{DD}-0.8$	-	-	V
Output Low Voltage ($I_{LOAD} = 1.6\text{mA}$) Port A,,B,C,D,TCMP	V_{OL}	-	-	0.4	V
Input High Voltage Port A,,B,C,D,TCAP,/IRQ,/RESET,OSC1	V_{IH}	$0.7 \times V_{DD}$	-	V_{DD}	V
Input Low Voltage Port A,,B,C,D,TCAP,/IRQ,/RESET,OSC1	V_{IL}	V_{SS}	-	$0.2 \times V_{DD}$	V
Supply Current (operating at 3.6864MHz clock)	I_{DD}	-	5	10	mA
I/O Ports High-Z Leakage Current Port A,,B,C,D,/RESET	I_{IL}	-	-	± 10	μA
Input Current /IRQ,TCAP,OSC1	I_{in}	-	-	± 1	μA
Capacitance Ports (as input or Output) /RESET,/IRQ,TCAP,PD7,PD5-PD0	C_{OUT}	-	-	12	pF
	C_{IN}	-	-	8	pF

8. AC2001 (in AC-Set) Pin Assignments: 24-Pin SOIC



9. Pin Function Description (AC2001)

Name	Description
PI0	This input pin is connected to AC1020 to control power to the smartcard
PO0	This output pin is connected to the interrupt pin of AC1020 to signal card insertion and removal
PMOD	This input/output pin output chip status or configure chip functions
/CS	Chip select input
RESET	Input pin controlled by AC1020 is translated to card reset signal (CRDRST)
IO	Input/Output pin connected to AC1020 is translated to card's IO signal (CRDIO)
CLKOUT	Output an inverted and buffered clock signal from ASYCLKIN pin. This pin can be connected to other AC2001 for multislot application.
ASYCLKIN	Asynchronous clock input which is translated to CRDCLK signal for microprocessor card. Connected to oscillator output of AC1020.
PI1	Connected to PB6 of AC1020. Clock input which is translated to CRDCLK signal for synchronous card.
CRDIO	Bidirection card interface pin connected to the serial I/O pin of the card connector.
CRDGND	Signal ground connected to the ground pin of the card connector
CRDVCC	Connected to Vcc pin of the card connector as reference signal for logic "1" of all signals at the card connector.
CRDRST	This pin connected to the RESET pin of the card connector.
CRDCLK	This pin connected to the CLK pin of the card connector. It is driven either by ASYCLKIN or PI1 depending on the type of card being used.
CRDC4	This pin connected to the C4 pin of the card connector. It has the same behaviour as CRDIO and can be used as a general purpose input/output.
PI2	This input pin connects to the card detect switch of the card connector for detecting card insertion or extraction.
PI3	This input pin connects to PGND or VBAT. If it is connected to PGND, the presence of card is signalled with a logic "1" on the PI2 pin. If it is connected to VBAT, the presence of card is

	signalled with a logic "0" on the PI2 pin.
CRDC8	This pin connected to the C8 pin of the card connector. It has the same behaviour as CRDIO and can be used as a general purpose input/output.
C8	Input/Output pin controlled by AC1020 is translated to card C8 signal (CRDC8).
C4	Input/Output pin controlled by AC1020 is translated to card C4 signal (CRDC4).
L1	This pin connects to an inductor for the internal DC/DC converter. Typical value of the inductor is 47µH.
VBAT	Power supply for the chip. Connects to same power source of AC1020.
ILIM	Connects this pin to PGND through a small resistor. Typical value of the resistor is 2 ohm. Smaller resistance will allow higher peak current supply to the card.
PGND	This pin provides return path for the current flowing into pin L1. Connects this pin to CRDGND using appropriate grounding techniques.

10. Maximum Ratings (AC2001)

AC2001 contains circuitry that protects the inputs against damage from high static voltages; however, do not apply voltages higher than those specified in the table below. For proper operation, input and output voltages should be constrained to the ranges indicated in the recommended operating conditions.

Rating	Symbol	Value	Unit
Battery Supply Voltage	V _{BAT}	7	V
Battery Supply Current	I _{BAT}	±200	mA
Power Supply Voltage	V _{CC}	6	V
Power Supply Current	I _{CC}	±150	mA
Digital Input Pins (2,4,5,6,7,9,10,17,18,20,21)	V _{IN} I _{IN}	-0.5 to V _{BAT} +0.5 ±5	V mA
Digital Output Pins (3,4,8)	V _{OUT} I _{OUT}	-0.5 to V _{BAT} +0.5 ±10	V mA
Card Interface Pins (11,13,14,15,16,19)	V _{Card} I _{Card}	-0.5 to V _{CC} +0.5 ±25	V mA
ESD Capability (Human body model): Standard Pins (2,3,4,5,6,7,8,9,10,17,18,20,21,22,23,24) Card Interface Pins (11,13,14,15,16,19)	V _{ESD}	2 4	kV kV
Operating Ambient Temperature Range	T _A	-40 to +85	°C
Storage Temperature Range	T _{stg}	-65 to +150	°C

11. DC Electrical Characteristics ($V_{BAT} = 5.0 \text{ Vdc}$) (AC2001)

Characteristic	Test Conditions	Symbol	Min	Typ	Max	Unit
Input High Voltage	All Digital Inputs (except pins 9, 18)	V_{IH}	$0.55 \cdot V_{BAT}$		$0.65 \cdot V_{BAT}$	V
Input Low Voltage	digital inputs (pins 2,5,6,10) pin 17 pin 4	V_{IL}	$0.3 \cdot V_{BAT}$ $0.2 \cdot V_{BAT}$ $0.3 \cdot V_{BAT}$		$0.45 \cdot V_{BAT}$ $0.40 \cdot V_{BAT}$ $0.5 \cdot V_{BAT}$	V
Switching Hysteresis	pin 2,4,5,6,10,17	V_{HYST}	$0.06 \cdot V_{BAT}$		$0.3 \cdot V_{BAT}$	V
Threshold Voltage	pin 9 pin 18	V_{TH}	$0.5 \cdot V_{BAT}$ $0.4 \cdot V_{BAT}$		$0.6 \cdot V_{BAT}$ $0.6 \cdot V_{BAT}$	V
Output High Voltage	$I_{OH} = -2.5 \mu\text{A}$, pin 3, pin 4 for /CS=H $I_{OH} = -20 \mu\text{A}$, pin 11, 16, 19 $I_{OH} = -50 \mu\text{A}$, pin 7, 20, 21 $I_{OH} = -0.2 \text{ mA}$, pin 8, 14, 15 pin 4 (in output mode)	V_{OH}	$V_{CC} - 1$ or $V_{BAT} - 1$			V
Output Low Voltage	corresponding input pin voltage $I_{OL} = 0.1 \text{ mA}$, pins 7,11,16,19,20,21 $I_{OL} = 0.2 \text{ mA}$, pins 3,4,8,14,15	V_{OL}			0.5	V
I/O Pull-up resistance, operating mode, /CS=L, PI0=H	$V_{OL} = 0.5 \text{ V}$, pin 11,16,19			18		$k\Omega$
Input Leakage Current	$V_{IN} = 2.5 \text{ V}$, /CS=H, pin 9,17,18,20,21	$\pm I_{leak}$			2	μA

12. Dynamic Electrical Characteristics (AC2001)

($V_{BAT} = 5.0$ Vdc, normal operating mode, pin loading = 30pF, except CLKOUT = 15pF)

Characteristic	Test Conditions	Symbol	Min	Typ	Max	Unit
Input Clock Frequency	pin 9, duty cycle = 50%	f_{asyclk}	16			MHz
Card Clock Frequency	pin 15	f_{ordclk}	8			MHz
Card Clock Duty Cycle	pin 15, 50% to 50% V_{CC}	r_{clk}	45		55	%
Card Clock Rise and Fall Time	pin 15, 10% \leftrightarrow 90% V_{CC}	t_{rclk}, t_{fclk}			9	% of clock period
I/O Data Transfer Frequency	pin [7,11], [21,16], [20,19] (note 1)	f_{io}	1			MHz
I/O Duty Cycle	pin [7,11], [21,16], [20,19] (note 1) 50% to 50% V_{CC}	r_{io}	45		55	%
I/O Rise and Fall Time	pin [7,11], [21,16], [20,19] (note 1) 10% \leftrightarrow 90% V_{CC}	t_{rio}, t_{fio}			15	% of clock period
I/O Transfer Time	pin [7,11], [21,16], [20,19] (note 1) 50% to 50% V_{CC} , L \rightarrow H,H \rightarrow L	t_{tr}			150	ns
Card Detection Filter Time:						
Card insertion		t_{fitin}	50		150	μ s
Card extraction		t_{fitout}	50		150	μ s

Note 1 : in either direction

13. Typical Application

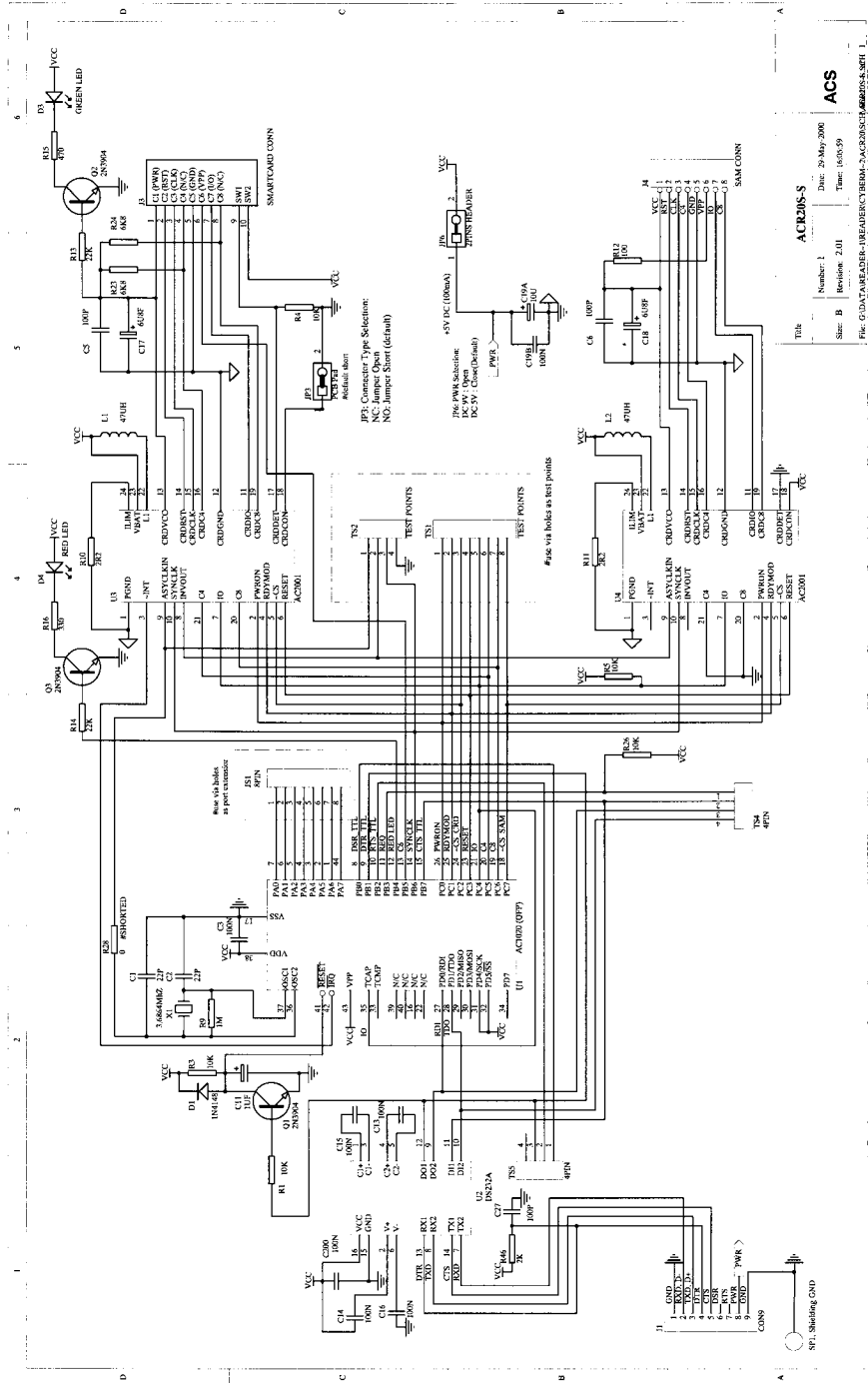


Figure 2. Card Reader Application of AC-Set

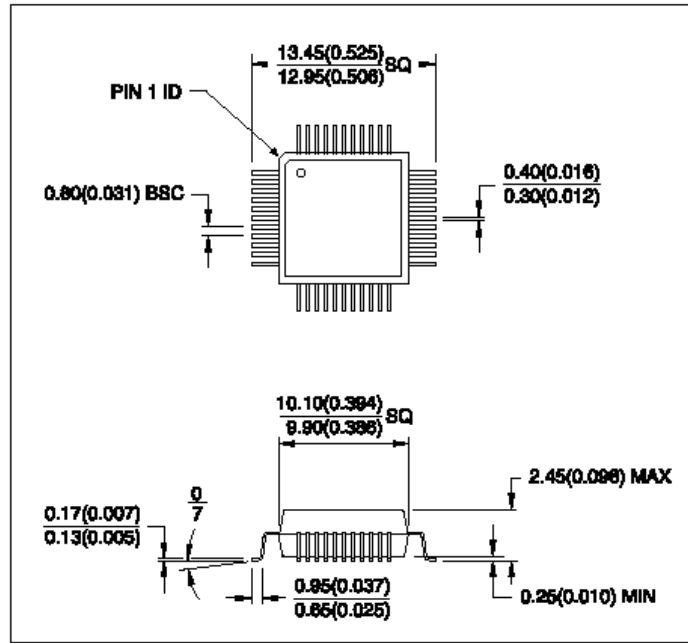


Figure 3. Package Drawing 44 Pin Quad Flat Pack (QFP-44)
Dimension in inches and (millimeters)

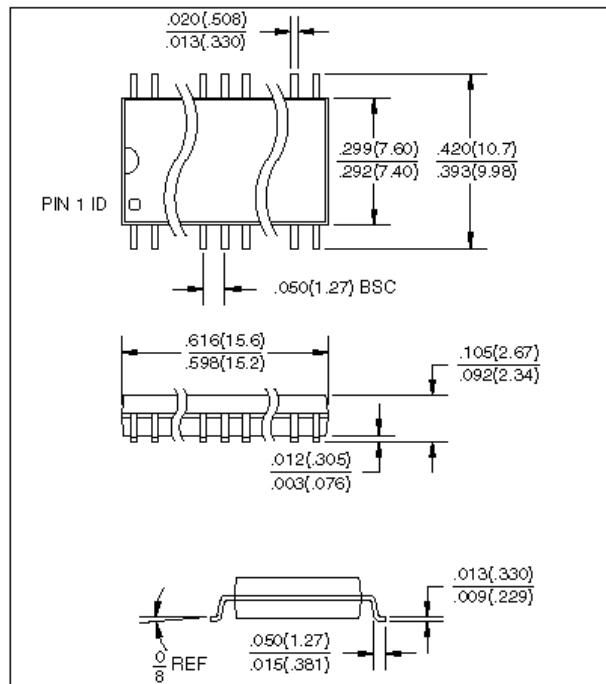


Figure 4. Package Drawing 24 Pin Small Outline Package (SO-24)
Dimension in inches and (millimeters)