ATC-SCC-04

Quad Channel Serial Communication Controller
RS-232 / 422 / 485 / TTL Industry Pack Module

REFERENCE MANUAL

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1. INTRODUCTION

The ATC-ATC-SCC-04 module from ALPHI TECHNOLOGY is a Serial Communication Controller based on the Zilog 85230 SCC and is implemented on a single wide Industry Pack according to the INDUSTRY PACK VITA 4 specification. Two types are available:

Reference Description

ATC-SCC-04A Four RS-232C serial channels

ATC-SCC-04B Four RS-422/RS-485 serial channels

ATC-SCC-04-ttl Four ttl level serial channels

–20 to +85 temperature grade version is available as a opt. ***-I***

ATC-SCC-04 Industry Pack provides four asychronous or synchronous full-duplex serial channels, with an seperate baud rate generator for each channel. An on-board non-volatile EEPROM maintains ATC-SCC-04 identification codes and provides additional user space.

2. SUMMARY OF FEATURES

- Single-size INDUSTRY PACK module.
- Four asynchronous and synchronous full-duplex serial channels.
- Fully compatible with the VITA 4 INDUSTRY PACK specification.
- RS-232 interface- ATC-SCC-04A
- RS-422/485 interface- ATC-SCC-04B
- TTL interface- ATC-SCC-ttl
- 4-Byte transmitter FIFO and the 8-Byte receiver FIFO
- Status FIFO anti-lock feature in DMA-driven system
- Separate baud rate generator for each channel.
- Data rate up to: 115 kbaud in async. mode, 2 Mbaud in synchronous mode.
- Supports multi-drop 2-wire configuration ATC-SCC-04B with driver output enable through /RTS signal.
- Zilog SCC Z85230 controller.
- 5 V only power supply.
- Extended temperature grade available (-40 to +85 °C).

3. DESCRIPTION

The ATC-SCC-04 is based on the Serial Communication Controller (SCC) Z85230 from Zilog. Each Z85230 provides two full-duplex ports for asynchronous and synchronous communication. The transmitter has an 8-bit transmit data register loaded from the internal data bus and a shift register loaded from the transmit data register. The receiver has a 4/8-Byte data FIFO with an 8-bit error FIFO, and a 8-bit shift register. This arrangement reduces CPU time overhead. The Z85230 interrupt structure supports vectorized or non-vectorized interrupts. The ATC-SCC-04A module provides superior performance, for multiple serial channels. Data transmission and reception are performed independently on each channel with five to eight data bits per character, plus optional even or odd parity. The transmitter can supply one, one and a half, or two stop bits per character. The full modem control signals of the four independent channels are available on the 50-pin INDUSTRY PACK I/O connector. The ATC-SCC-04B module provides four RS-422/485 channels. It is especially oriented for high speed synchronous communications and allows the connection of up 32 transmitters and receivers to a single multi drop bus (2-wire).

3.1 BLOCK DIAGRAM

There are four basic section to the ATC-SCC-04:

- The INDUSTRY PACK bus interface.
- The Z85230 controllers.
- The serial communication physical interface: RS-232C for the ATC-SCC-04A, or RS-422/RS-485 for the ATC-SCC-04B, ATC-SCC-04-ttl.
- The 2 kByte of non-volatile memory.

3.2 INDUSTRY PACK SPACES

The following table gives the four ATC-SCC-04 memory spaces.

- **ID space** INDUSTRY PACK identification codes
- **I/O space** CIO controllers access
- **INT Ack** Interrupt acknowledge

The base address of these spaces depends on the specific INDUSTRY PACK carrier used .

3.3 I/O SPACE

The two Z85230 controllers are mapped into the INDUSTRY PACK I/O space. Data and command registers of the Z85230 controllers are placed on 8 consecutive addresses (8-bit data path).

DSP Carrier I/O space addr.	Register	Description
	Z85230 (0) controller	
$0	CBCR	Channel B Command Register
$1	CBDR	Channel B Data Register
$2	CACR	Channel A Command Register
$3	CADR	Channel A Data Register
	Z85230 (1) controller	
$4	CDCR	Channel D Command Register
$5	CDDR	Channel D Data Register
$6	CCCR	Channel C Command Register
$7	CCDR	Channel C Data Register
$10	85230 CLK	0 = 8Mhz / 1 = 16Mhz

Slave Carrier I/O space addr.	Register	Description
	Z85230 (0) controller	
$0	CBCR	Channel B Command Register
$4	CBDR	Channel B Data Register
$8	CACR	Channel A Command Register
$C	CADR	Channel A Data Register
	Z85230 (1) controller	
$10	CDCR	Channel D Command Register
$14	CDDR	Channel D Data Register
$18	CCCR	Channel C Command Register
$1C	CCDR	Channel C Data Register
$40	85230 CLK	0 = 8Mhz / 1 = 16Mhz

All port configurations are defined with the Z85230 control registers. The data registers allow the transmit/receive data of each channels to be accessed directly.

3.4 ID SPACE

The identification space is defined as follows:

ID space addr.	Description	value
$01	Ascii "I"	$49
$03	Ascii "P"	$50
$05	Ascii "A"	$41
$07	Ascii "C"	$43
$09	Manufacturer identification	$11
$0B	Module type	
$0D	Revision module	
$0F	Reserved $00	
$11	Driver ID	low byte
$13	Driver ID	high byte
$15	Number of bytes used	$0C
$17	CRC	
$3F-	user	
$19	user	

The four first bytes contain the ASCII text "IPAC". This clearly identifies the ROM beginning. The manufacturer code identifies ALPHI TECHNOLOGY INDUSTRY PACKs.

The ATC-SCC-04 device is defined as follows by the module type byte.

Module Module	type byte
ATC-SCC-04A	$04
ATC-SCC-04B	$05
ATC-SCC-04-ttl	$09

The next byte identifies the INDUSTRY PACK revision, in accordance with the following definition.

Revision	ASCII char.	hex value
first	"_" (space)	$5F
next	"A" "B"	... $41 $42

The byte $0F is reserved for future extension. The bytes $11 and $13 allow the identification of the INDUSTRY PACK software driver. The number of bytes used in the identification space is stored at address $15.

To verify the identification data integrity, the byte $17 contains a 8-bit Checksum (CRC). This CRC covers only the number of identification codes set by the manufacturer. The CRC used is an industry standard. It's the low 8-bit of the FCS as described in CCITT T.30 (Fascicle VII.3) section 5.3.7.

The next bytes $19 to $3F are free for user data storage.

3.5 WAIT STATE CYCLES

The following table gives the number of wait states asserted in each INDUSTRY PACKs space.

Space	Wait state Read	Wait state Write
I/O	2	2
Identification	2	2
Interrupt ack.	6	N/A

4. ATC-SCC-04 CHARACTERISTICS

Symbol	Parameters	Test	Max	Unit
BR	Baud rate	Asynchronous	115	kBaud
BR	Baud rate	Synchronous	2	MBaud
ICC	Vcc current		670	mA
PCLK	Peripheral clock		8	MHz
ATC-SCC-04	(commercial)		0 to +70	°C
ATC-SCC-04X	(industrial)		-40 to +85	°C
Tstg	Storage temperature		-60 to 150	°C

5. ZILOG SCC Z85230

The ATC-SCC-04 INDUSTRY PACK contains two NMOS Z8530 devices, and the following description gives you the features of these Z85230 controllers. Each Z8530 device provides two full-duplex serial channels for multiprotocol asynchronous and synchronous transmission modes. The Z85230 handles asynchronous formats, synchronous byte-oriented protocols such as IBM ® Bisync, and synchronous bit-oriented protocol such as HDLC and IBM ® SDLC. This versatile device supports virtually any serial data transfer application. The Z85230 can generate and check CRC codes in any synchronous mode and can be programmed to check data integrity in various modes. The device also has facilities for modem control in both channels. Each Z85230 channel provides a receiver FIFO of 8 Bytes deep, and a transmitter FIFO of 4 byte deep.

Each Z85230 controller provides an interrupt connected to IRQ0 and IRQ1 of the INDUSTRY PACK logic interface respectively.

6. BAUD RATE GENERATOR

The Z85230 provides a baud rate generator for each channel, consisting of one16-bit time-constant register, a 16-bit down-counter, and a flip-flop on the output that makes the output a square wave. The down-counter clock is divided by the clock mode value, and the clock mode source allows to select the master clock between the system clock PCLK and the input pin RTxC

On startup, the value in the time constant-register is loaded into the counter, and the counter begins counting down. When a count of zero is reached, the output of the baud rate generator toggles, the time-constant value is loaded into the counter, and the process repeats. In asynchrounous mode, two clock sources are available: PCLK pin (8 MHz) with clock mode equal to 16, 32 or 64, or RTxC pin (2.4576 MHz) with clock mode equal to 1.

In synchronous mode (ATC-SCC-04B and ATC-SCC-04C modules) - RTxC pin (Receive clock line) is the clock source -, the clock mode selection is always equal to 1. The mode clock value representes the frequency ratio between the data rate output and the frequency sample of the received character. The following formula allows to define the desired baud rate output:

6.1 ASYNCHRONOUS MODE

In this transmission mode, an asynchronous message format is defined as follows:

- A start bit
- The data field
- The parity bit
- Stop bit(s)

The start bit indicates the beginning of the character transmission. The data field contains the character to be transmited, and the number of bits per character can be set from 5 to 8. The parity bit generation and checking is optional. For even parity, the parity bit is set when the data bits plus the parity bit contain an even number of 1s. For odd parity, the parity bit is set when the data bits plus the parity bit contain an odd number of 1s. The stop bit(s) signal(s) the end of transmit character, and provide(s) a minimum interval between two emission characters. The available number of stop bit is one, one and a half, and two. There are four modem control signals, associated with the transmitter, provided by the Z85230: /RTS, /CTS, /DTR and /DCD. When the auto enable function is set (for more information, refer to the Zilog Z85230 User's manual), the /RTS

signal remains low until the transmitter is completely empty and the last stop bit has left the TxD pin. The /CTS line becomes active when the transmitter is enabled. The /DCD line becomes active when the receiver is enabled. The /DTR signal goes low to indicate the terminal ready state, and goes high when the transmit is reseted. If these control functions are not required, these pins can be used as general-purpose I/O signals.

The receive data path provides an error FIFO in parallel with the data FIFO. Three error conditions that the receiver checks in asynchronous mode are:

- Framing error - when the data length is too long.
- Parity error - The parity bit disagrees with the programmed sens.
- Overrun errors - When the receive FIFO overflows.

6.2 SYNCHRONOUS MODE

The synchronous versus asynchronous communication requires a common clock signal reference to both transmitter and receiver. This solution eliminates the overhead associated with every character (start and stop bits in asynchronous mode) and increases the line efficiency. In the receiver data path, the mode clock must be equal to one that allows higher speed communication links. Some applications may encode the clock information on the same line as the data. Because of the phase relationship of synchronous data to a clock, data is transferred in blocks with no gaps between characters. A synchronization pattern (6-bit, 8-bit, or 16-bit length) is normally used to indicate the location of a block transmission. For example monosync protocol usually uses $16 as this special character, and the SDLC protocol uses the $7E character to mark the beginning and the end of a block of data. The Z85230 supports the three following byte-oriented protocols:

monosynchronous, bisynchronous, and external synchronous

The Z85230 offers several options to support synchronous mode including various sync generation and checking, CRC generation and checking, as well as modem controls, and a transmitter to receiver synchronization function. In synchronous communication the number of bits per character can be set between five, six, seven, or eight. An additional - odd or even - parity bit can be carried for each transmit character. Typically the parity bit is not used in synchronous applications because the CRC provides a more reliable method for detecting errors. Either the CRC-16 polynomial or the CRC-CCITT polynomial may be used to check the data integrity. The modem control signals /RTS and /CTS, in synchronous transmission, are used as simple I/O pin.

Note: On the ATC-SCC-04B, the /RTS signal controls the output enable driver of the RS-422/RS-485 serial interface. In this way, before each transmission, the /RTS signal must be set to low, and automatically return to the high state at the end of the complete block transmission to insure no collision.

In bit-oriented protocol (Synchronous Data Link Control mode, SDLC), the synchronization character is similar to bisync and monosync modes. High level Data Link Control (HDLC) is defined as CCITT, also EIAJ standards:

SDLC is one of the implementation made by IBM ® . Frames of information are enclosed by a unique bit pattern called a flag, usually equal at $7E. The basic format of an SDLC/HDLC frame is described as following:

- A 8-bit flag character ($7E), to mark the frame beginning.
- A 8-bit address field, it is used to designed receiving stations.
- A 8-bit control field.
- The data information field.
- A 16-bit frame checking field, in SDLC mode only the CRC-CCITT is used.
- A 8-bit flag character ($7E), to mark the frame ending.

6.3 DATA ENCODING

Four data encoding capabilities are provided by the Z85230 to allow the transmit of the data information and the clock transmission one the same line.

- **NRZ** (Non-Return to Zero), encoding a 1 is represented by a high level and a 0 is represented by a low level.
- **NRZI** (Non-Return to Zero Inverted), encoding a 1 is represented by no change in the level and a 0 is represented by a change in the level.
- **FM1** (biphase mark), a transition is present on every transmit bit, encoding a 1 is represented by an additional transition presents in the bit middle, the 0 state contains no transition in the bit middle. The FM1 encoded data contains sufficient information to recover a clock from the data.
- **FM0** (biphase space), the encoding method is the same that FM1, but the 1 is represented such as a 0 in FM1 encoding, also the 0 level is encoded such as the 1 in FM1.

Each Z85230 channel contains a Digital Phase-Locked Loop (DPLL) that can be used to recover the clock information from the received data with NRZ, NRZI, FM1 and FM0 encoding.

6.4 Z85230 INTERRUPT FUNCTION

The Z85230 operations must be controlled by polling or interrupt modes. In polling mode, the Z85230 transmitter/receiver status is show by a continuous reading into the Z85230 status registers (for more information, refer to the Zilog Z85230 User's maual). The interrupt mode reduces the CPU overhead system. Three Z85230 sources can generate an interrupt request: the receiver, the

transmitter and the external/status, this makes a total of six Z85230 interrupt sources (total of twelve interrupt sources into the ATC-SCC-04 module). The Z85230 is very flexible for interrupt acknowledge method, it supports vectorized or non-vectorized cycle.The following table gives the several Z85230 interrupt sources.

Interrupt source	Condition
Receiver	
	Character available
	Receive overrun
	Framing error
	End of frame (SDLC)
	Parity error
Transmitter	
	Buffer empty
External/Status	
	Zero count
	DCD
	SYNC/HUNT
	CTS
	Tx underrun/EOM
	Break/Abort

Channel A (or C) has a higher priority than channel B (or D) with the six interrupt sources. This source priority is showed in the following table.

Priority level	Interrupt source
Highest	Receive channel A or C
	Transmit channel A or C
	External/Status channel A or C
	Receive channel B or D
	Transmit channel B or D
Lowest	External/Status channel B or D

The hardware daisy-chain operation is not implemented, because each CIOcontroller has its own interrupt request line into the INDUSTRY PACK logic interface. In the ATC-SCC-04 module, the Z85230(0) interrupt line is connected to the /IRQ0, and the Z85230(1) interrupt line is connected to the /IRQ1 signal on the INDUSTRY PACK logic interface.

6.5 Z8530 REGISTERS ACCESS

Two cycles are necessary to address an internal register, as the internal Z85230 registers are accessed through an internal pointer register. The first cycle is the write pointer operation, into the Write Register 0 which selects the internal register. The next cycle is the data access operation.

The following state machine shows the internal register operation. The state 0 waits for the pointer writing (in the Write Register 0) which selects the internal register selection. After the data access (read or write cycle), the state machine returns to the state 0, waiting for the next pointer writing. A **minimum time of 500 ns** is required between the pointer writing and the data access operation.

All internal CIO registers, including the internal data register, are accessed through this method. The pointer register is automatically cleared after each following read or write cycle. For more details on register programming and Z85230 functionalities, please refer to the Zilog "Z85230 User's manual".

7. ATC-SCC-04A CONNECTION

The ATC-SCC-04A signals of the four RS-232C serial communication channels are present on the 50-pin INDUSTRY PACK I/O connector. The power supply +5V is also provided for external signal conditioning, and it's short-circuit protected from ATC-SCC-04A revision "A" module.

Signals	Description	
TxD	Transmit Data	
RxD	Receive Data	
/RTS	Request To Send	
/CTS	Clear To Send	
/DTR	Data Set Ready	
/DCD	Data Carrier Detect	
VDD	+ 5 V 500 mA max. Fuse protected on	
GND	Ground	

This connection is compatible with the I/O connection standard, on the 50-pin INDUSTRY PACK I/O connector, defined by ALPHI TECHNOLOGY. An adaptor module (RJ45Q) from ALPHI TECHNOLOGY is also available for an easily user connection. It provides four RJ-45 connectors and measures 3HE x 4TE on front panel.

7.1 SCC-04A: I/O 50 PIN CONNECTOR DESCRIPTION.

PIN	SIGNAL	PIN	SIGNAL
1	GND	26	GND
2	NC	27	DCDC
3	DCDA	28	RTSC
4	RTSA	29	GND
5	GND	30	GND
6	GND	31	NC
7	VDD	32	VDD
8	NC	33	TXDC
9	TXDA	34	RXDC
10	RXDA	35	CTSC
11	CTSA	36	DTRC
12	DTRA	37	NC
13	GND	38	GND
14	NC	39	DCDD
15	DCDB	40	RTSD
16	RTSB	41	GND
17	GND	42	GND
18	GND	43	NC
19	VDD	44	VDD
20	NC	45	TXDD
21	TXDB	46	RXDD
22	RXDB	47	CTSD
23	CTSB	48	DTRD
24	DTRB	49	NC
25	GND	50	GND

Note: NC: No Connect

VDD: 5 volt Fused

8. ATC-SCC-04B CONNECTION

The ATC-SCC-04B/C differential signals of the four RS-422 / RS-485 serial communication channels are present on the 50-pin INDUSTRY PACK I/O connector. The power supply +5V is also provided for external signal conditioning, and it's short-circuit protected from ATC-SCC-04B/C revision "A" module.

Signals	Description
TxD±	Transmit Data
RxD±	Receive Data
TxC±	Transmit Clock
RxC±	Receive Clock
VDD	+ 5 V 500mA Fuse protected
GND	Ground

This connection is compatible with the I/O connection standard, on the 50-pin INDUSTRY PACK I/O connector, defined by ALPHI TECHNOLOGY. An adapter module (RJ45Q) from ALPHI TECHNOLOGY is also available for an easily user connection.

8.1 SCC-04B: I/O 50 PIN CONNECTOR DESCRIPTION.

PIN	SIGNAL	PIN	SIGNAL
1	GND	26	GND
2	NC	27	TXDC+
3	TXDA+	28	TXDC-
4	TXDA-	29	RXDC+
5	RXDA+	30	RXDC-
6	RXDA-	31	NC
7	+5VF	32	+5VF
8	NC	33	TXCC+
9	TXCA+	34	TXCC-
10	TXCA-	35	RXCC+
11	RXCA+	36	RXCC-
12	RXCA-	37	NC
13	GND	38	GND
14	NC	39	TXDD+
15	TXDB+	40	TXDD-
16	TXDB-	41	RXDD+
17	RXDB+	42	RXDD-
18	RXDB-	43	NC
19	+5VF	44	+5VF
20	NC	45	TXCD+
21	TXCB+	46	TXCD-
22	TXCB-	47	RXCD+
23	RXCB+	48	RXCD-
24	RXCB-	49	NC
25	GND	50	GND

Note:

NC: No Connect

+5VF: 5 volt Fused

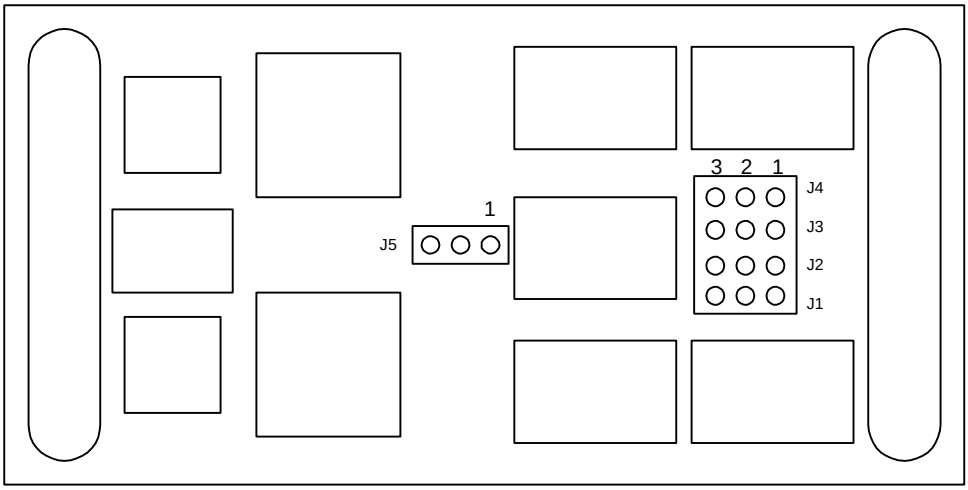
9. ATC-SCC-04-TTL CONNECTION

The ATC-SCC-04-ttl ttl buffered signals. The power supply +5V is also provided for external signal conditioning, and it's short-circuit protected.

Signals	Description
TxD	Transmit Data
RxD	Receive Data
TxC±	Transmit Clock
RxC±	Receive Clock
/RTS	Request to send
/CTS	Clear to send
/DTR	Data set ready
/DCD	Data carrier detect
VDD	+ 5 V 500Ma fused
GND	Ground

This connection is compatible with the I/O connection standard, on the 50-pin INDUSTRY PACK I/O connector, defined by ALPHI TECHNOLOGY. An adapter module (RJ45Q) from ALPHI TECHNOLOGY is also available for an easily user connection.

9.1 CLOCK SOURCES



J1, J2, J3, J4 Clock source for RTxC

- Pin 1 to 2 jumpered is for external clock on P2
- Pin 2 to 3 jumpered Internal clock

J5 Clock source for TRxC

- Pin 1 to 2 jumpered is for input clock
- Pin 2 to 3 jumpered is for output clock

9.2 SCC-04TTL: I/O 50 PIN CONNECTOR DESCRIPTION.

PIN	SIGNAL	PIN	SIGNAL
1	GND	26	GND
2	NC	27	/DCDc
3	/DCDa	28	/RTSc
4	/RTSa	29	TXCc
5	TXCa	30	RXCc
6	RXCa	31	+12V
7	Vdd	32	Vdd
8	+12V	33	TXDc
9	TXDa	34	RXDc
10	RXDa	35	/CTSc
11	/CTSa	36	/DTRc
12	/DTRa	37	NC
13	GND	38	GND
14	NC	39	/DCDd
15	/DCDb	40	/RTSd
16	/RTSb	41	TXCD
17	TXCb	42	RXCd
18	RXCb	43	VDD
19	VDD	44	-12V
20	-12V	45	TXDd
21	TXDd	46	RXDd
22	RXDb	47	/CTSd
23	/CTSb	48	/DTRd
24	/DTRb	49	NC
25	GND	50	GND

NC: No Connect

10. ADENDUM TO MANUAL

This product has been modified in the Altera code to work with an IP-CLK of 8Mhz or 32Mhz by adding a control register accessed on the I/O space address $10 of DSP carrier or $40 of a slave carrier board. The register controls the clock speed of the 85230 on board. The 85230's are either 16Mhz or 20Mhz so they can only run at 8Mhz or 16Mhz, there is a 32Mhz condition with this register that cannot be used. A table below we show each condition .

CONTROL REGISTER (Read/Write)
Address ($10 with Alphi DSP carrier) and ($40 with slave carrier)

IPCLK	REGISTER $10 WRITE	85230-PCLK INPUT	CONDITION
8Mhz	0	8Mhz	RD/WR 240ns
8Mhz	1	4Mhz	N/A
32Mhz	0	32Mhz	N/A
32Mhz	1	16Mhz	RD/WR 60ns