7I52 MANUAL

6 channel RS-422 + 6 channel encoder interface

V1.5

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GENERAL

DESCRIPTION

The 7I52 is a six channel RS-422 serial plus six channel encoder interface for Mesas Anything I/O series of FPGA interface cards. The 7I52 is designed for motion control applications.

A common usage of the 7I52 would be connecting up to six serially interfaced drives or I/O modules to the 7I52s six full duplex RS-422 interfaces and up to six encoders with index to the 7I52s encoder inputs. Two of the 7I52s serial links support RS-485 (shared bus) interfaces. Encoder inputs can be TTL or differential on a per input basis. The 7I52 can also supply 5V power to encoders. A 7I52S version is available that replaces the six serial interfaces with 12 differential ouputs that can be used as six differential step+ dir output pairs or PWM outputs, SSI interfaces or other output functions.

The controller connection is a 50 pin header that matches the pinout of Mesa's Anything I/O cards. All buffered I/O is terminated with 3.5 mm pluggable screw terminals (supplied)

HARDWARE CONFIGURATION

GENERAL

Hardware setup jumper positions assume that the 7I52 card is oriented in an upright position, that is, with the 50 pin controller connector is on the left hand side.

DEFAULT CONFIGURATION

JUMPER	FUNCTION	DEFAULT SETTING
W3	CABLE/EXT 5V POWER	LEFT = EXT 5V POWER
W15,W18,W20	ENCODER 0	ALL DOWN = RS-422
W9,W11,W13	ENCODER 1	ALL DOWN = RS-422
W2,W5,W7	ENCODER 2	ALL DOWN = RS-422
W14,W17,W19	ENCODER 3	ALL DOWN = RS-422
W8,W10,W12	ENCODER 4	ALL DOWN = RS-422
W1,W4,W6	ENCODER 5	ALL DOWN = RS-422

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TTL/RS-422 ENCODER SELECTION

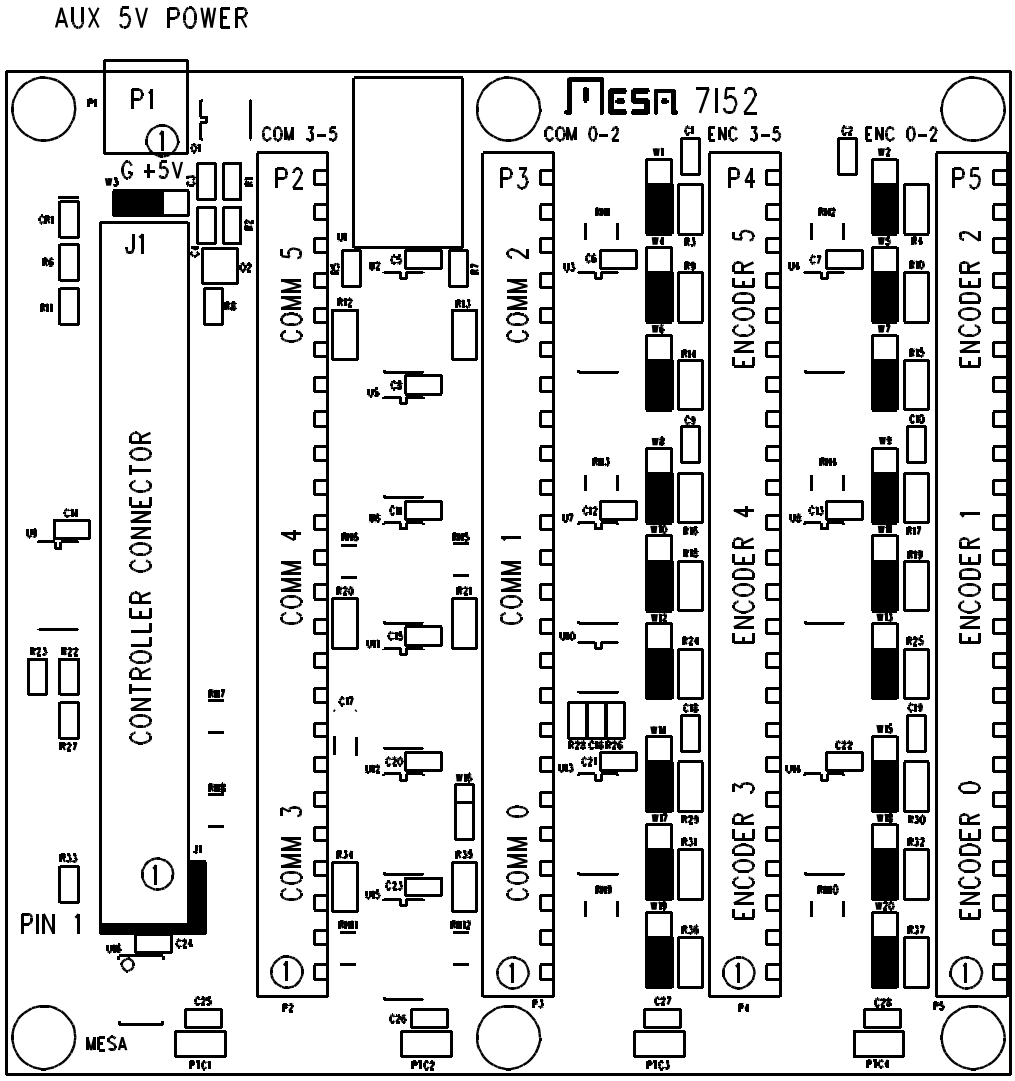
Each 7I52 encoder channel has a selectable TTL or RS-422 (differential) encoder input conditioning. Conditioning type is determined by setting groups of 3 jumpers to the up or down position. When the jumpers are in the "UP" position, TTL inputs are selected, When the jumpers are in the "DOWN" position, RS-422 inputs are selected. Note these sets of three jumpers are in physical proximity to the terminal block encoder connections.

CABLE POWER/P1 POWER SELECTION

The 7I52 can get its operating power from the flat FPGA cable or from P1. For testing and with very low power encoders, cable power can be used. W3 selects whether cable power connects to the 7I52s 5V supply. If W3 is in the "RIGHT" position, cable power is selected. If W3 is in the "LEFT" position, external 5V power must be supplied via P1.

CONNECTORS

CONNECTOR LOCATIONS AND DEFAULT JUMPER POSITIONS



CONNECTORS

CONTROLLER CONNECTOR

50 pin header connector J1 connects to the anything I/O card/motion controller. This can be a male 50 pin header on the top of the 7I52 card or a female 50 conductor header on the bottom side of the 7I52 depending on 7I52 model.

PIN	FUNCTION	DIRECTION	PIN	FUNCTION	DIRECTION
1	TXEN3	TO 7I52	25	RX5	FROM 7I52
3	MENCA0	FROM 7I52	27	TX4	TO 7I52
5	MENCB0	FROM 7I52	29	RX4	FROM 7I52
7	MIDX0	FROM 7I52	31	TX3	TO 7I52
9	MENCA1	FROM 7I52	33	RX3	FROM 7I52
11	MENCB1	FROM 7I52	35	TX2	TO 7I52
13	MIDX1	FROM 7I52	37	RX2	FROM 7I52
15	MENCA2	FROM 7I52	39	TX1	TO 7I52
17	MENCB2	FROM 7I52	41	RX1	FROM 7I52
19	MIDX2	FROM 7I52	43	TX0	TO 7I52
21	ENCMUX	TO 7I52	45	RX0	FROM 7I52
23	TX5	TO 7I52	47	TXEN0	TO 7I52
			49	+5V PWR	TO 7I52

Note: all even pins are grounded. Alternate encoder names omitted for space. The ‘M’ prefix on the interface encoder signals is to indicate that they are multiplexed signals.

EXT 5V POWER

2 pin pluggable terminal P1 can be used to supply 5V power to the I/O terminals on the7I52. This is suggested for most applications as the encoders typically will draw more current than can be supplied via the FPGA flat cable. P1 has the following pinout:

PIN	FUNCTION
1	5V
2	GND

CONNECTORS

ENCODER CONNECTOR P5

Connector P5 is a 3.5MM pluggable screw terminal block with encoder channels 0 through 2:

P5 PIN	FUNCTION	DIR
1	QA0	TO 7I52
2	/QA0	TO 7I52
3	GND	FROM 7I52
4	QB0	TO 7I52
5	/QB0	TO 7I52
6	+5V	FROM 7I52
7	IDX0	TO 7I52
8	/IDX0	TO 7I52
9	QA1	TO 7I52
10	/QA1	TO 7I52
11	GND	FROM 7I52
12	QB1	TO 7I52
13	/QB1	TO 7I52
14	+5V	FROM 7I52
15	IDX1	TO 7I52
16	/IDX1	TO 7I52
17	QA2	TO 7I52
18	/QA2	TO 7I52
19	GND	FROM 7I52
20	QB2	TO 7I52
21	/QB2	TO 7I52
22	+5V	FROM 7I52
23	IDX2	TO 7I52
24	/IDX2	TO 7I52

Note that actual signal functions depend on FPGA configuration.

CONNECTORS

ENCODER CONNECTOR P4

Connector P4 is a 3.5MM pluggable screw terminal block with the following pinout:

P3 PIN	FUNCTION	DIR
1	QA3	TO 7I52
2	/QA3	TO 7I52
3	GND	FROM 7I52
4	QB3	TO 7I52
5	/QB3	TO 7I52
6	+5V	FROM 7I52
7	IDX3	TO 7I52
8	/IDX3	TO 7I52
9	QA4	TO 7I52
10	/QA4	TO 7I52
11	GND	FROM 7I52
12	QB4	TO 7I52
13	/QB4	TO 7I52
14	+5V	FROM 7I52
15	IDX4	TO 7I52
16	/IDX4	TO 7I52
17	QA5	TO 7I52
18	/QA5	TO 7I52
19	GND	FROM 7I52
20	QB5	TO 7I52
21	/QB5	TO 7I52
22	+5V	FROM 7I52
23	IDX5	TO 7I52
24	/IDX5	TO 7I52

Note that actual signal functions depend on FPGA configuration.

CONNECTORS

RS-422 INTERFACE CONNECTOR P3

Connector P3 is a 3.5MM pluggable screw terminal block with the following pinout:

P3 PIN	FUNCTION	DIR
1	GND	FROM 7I52
2	GND	FROM 7I52
3	RX0	TO 7I52
4	/RX0	TO 7I52
5	TX0	FROM 7I52
6	/TX0	FROM 7I52
7	+5V	FROM 7I52
8	+5V	FROM 7I52
9	GND	FROM 7I52
10	GND	FROM 7I52
11	RX1	TO 7I52
12	/RX1	TO 7I52
13	TX1	FROM 7I52
14	/TX1	FROM 7I52
15	+5V	FROM 7I52
16	+5V	FROM 7I52
17	GND	FROM 7I52
18	GND	FROM 7I52
19	RX2	TO 7I52
20	/RX2	TO 7I52
21	TX2	FROM 7I52
22	/TX2	FROM 7I52
23	+5V	FROM 7I52
24	+5V	FROM 7I52

Note that actual signal functions depend on FPGA configuration.

CONNECTORS

RS-422 CONNECTOR P2

Connector P2 is a 3.5MM pluggable screw terminal block with the following pinout:

P2 PIN	FUNCTION	DIR
1	GND	FROM 7I52
2	GND	FROM 7I52
3	RX3	TO 7I52
4	/RX3	TO 7I52
5	TX3	FROM 7I52
6	/TX3	FROM 7I52
7	+5V	FROM 7I52
8	+5V	FROM 7I52
9	GND	FROM 7I52
10	GND	FROM 7I52
11	RX4	TO 7I52
12	/RX4	TO 7I52
13	TX4	FROM 7I52
14	/TX4	FROM 7I52
15	+5V	FROM 7I52
16	+5V	FROM 7I52
17	GND	FROM 7I52
18	GND	FROM 7I52
19	RX5	TO 7I52
20	/RX5	TO 7I52
21	TX5	FROM 7I52
22	/TX5	FROM 7I52
23	+5V	FROM 7I52
24	+5V	FROM 7I52

Note that actual signal functions depend on FPGA configuration.

OPERATION

5V POWER

The 7I52 requires ~200 mA of 5V power for operation. This power will increase based on the number of terminated TX outputs used, up to a maximum of ~400 mA of local logic power. Encoder power and remote serial device power must be added to this figure for total power draw

Power for the 7I52 logic is normally supplied from P1, the EXT 5V power connector. The 7I52 incorporates a high-side power switch to enable 5V power to all logic and I/O connectors only when 5V cable power is present. This allows the 7I52s EXT 5V power to be supplied continuously to P1 without the risk of reverse powering the FPGA card when the PC is turned off.

If W3 is on the right hand position, the controller cable will supply both the logic and I/O power and P1 can remain unconnected. This mode can be used for testing with perhaps a single encoder and single RS-422 channel, but it is suggested that W3 be placed in the left hand position and I/O power be supplied via P1 for most applications.

The 5V power to I/O connectors P2,P3,P4 and P5 each pass through a 1.1A PTC device before being routed to the I/O terminals. This limits the I/O power supplied by P2, P3,P4 and P5 to ~640 mA each in a 0 to 70C ambient temperature range.

ENCODER INPUT CIRCUIT

The 7I52 input circuit is different depending on whether TTL or RS-422 encoder types have been selected. In TTL mode the input circuit on the encoder QA, QB, and IDX inputs drive one input of the RS-422 differential receiver, and the other receiver input is terminated to a 1.6V (TTL threshold) reference voltage. In RS-422 mode, the input consists of a 120 Ohm termination resistor and a 26LS32 RS-422 differential receiver.

When TTL encoders are used, they connect to the ‘True’ input of the differential pair, for example a TTL encoder for channel 2 would connect to QA2, QB2 and IDX2, while the /QA2, /QB2, and /IDX2 terminals would be left open.

Fine print: normally the input mode jumpers would always be moved as a sets of three to select TTL or RS-422 mode for individual encoders, however it is possible to select TTL or RS-422 mode for each encoder signal, for example if a encoder had a differential A, B but TTL index, the input circuit can accommodate this. The three input mode select jumpers are in bottom to top order: QA, QB, IDX.

OPERATION

MAXIMUM ENCODER COUNT RATE

The 7I52 uses multiplexed encoder signals to save interface pins. The multiplexing rate will determine the maximum encoder count rate. Default multiplexing rate with HostMot2 firmware is ClockLow / 8,or approximately 4 or 6 MHz, giving a resolvable count rate of 2 to 3 MHz. Multiplexing rate can be increased if desired but high multiplex rates will require short cables between the FPGA controller card and the 7I52 due to signal integrity and time-of-flight considerations. Maximum practical multiplex rate is approximately 12 MHz (and 6 MHz count rates). Encoder count rate is further limited by HostMot2s input filtering to ~5 to ~8 million counts per second (encoder filtering off) and ~1 to ~1.6 million counts per second (encoder filtering on).

RS-485 CAPABLE CHANNELS

Two of the serial channels on the 7I52 have output enables and can be used for RS-485 half duplex type applications. These are channels 0 and 3. For 2 wire half duplex type RS-485 interfaces, the RX+ and TX+ lines and the RX- and TX- lines should be tied together at the 7I52.

INTERFACING WITH MESA SERIAL DEVICES

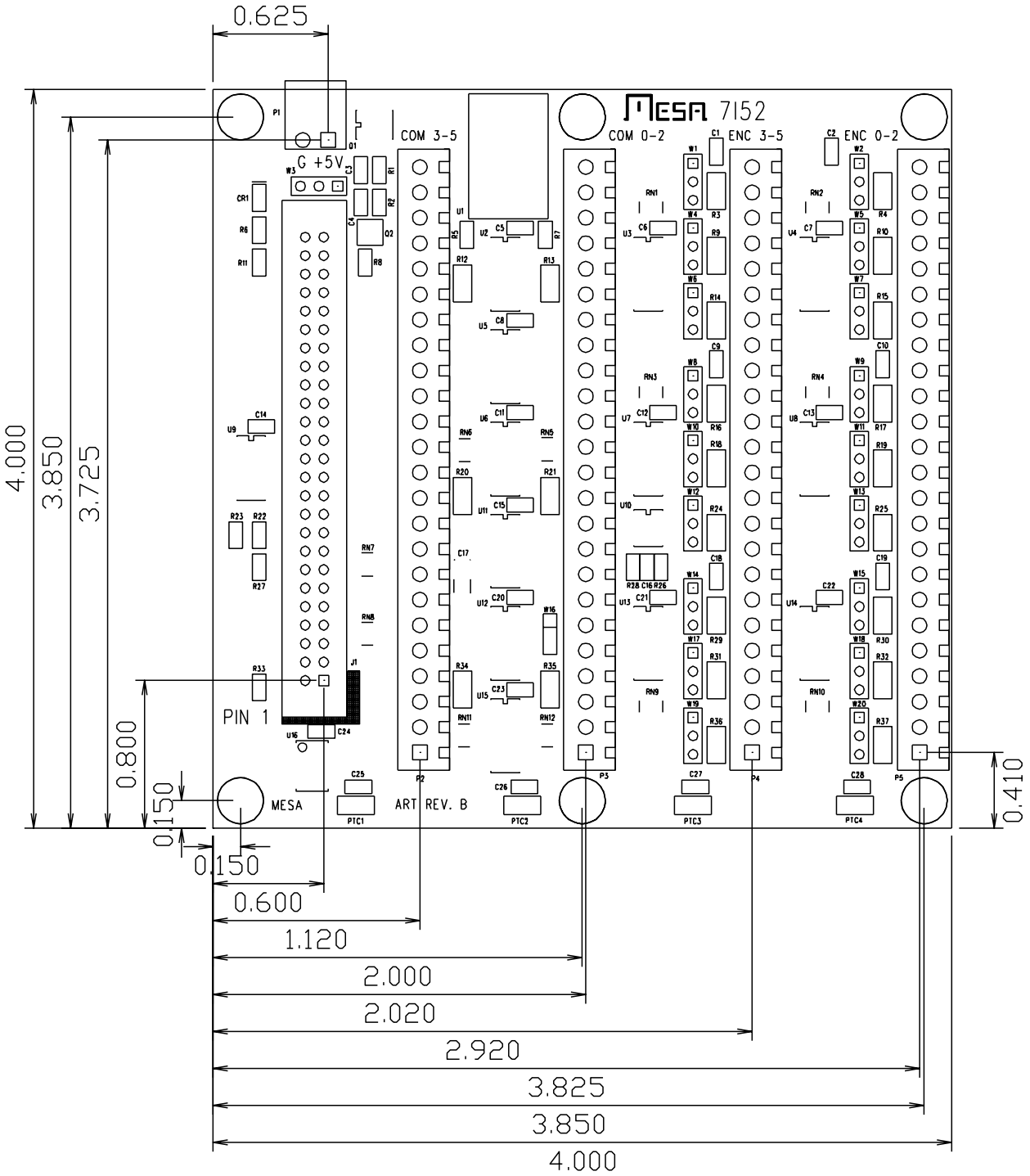
The 7I52 in intended to be a general purpose RS-422 serial plus encoder interface but can easily interface to MESA's serial I/O devices that use RS-422 communication and RJ45/CAT5 cable for the serial interface. These devices include the 7I64 Isolated I/O interface, the 8I20 3 phase drive, the 7I66 isolated I/O interface, the 7I69 TTL I/O interface and the 7I73 pendant interface. The easiest way to make a cable for interfacing the 7I52 to these devices is to take a standard CAT5 or CAT6 cable, cut it in half, and wire the individual wires to the 7I52 screw terminals. The following chart gives the CAT5 to 7I52 screw terminal connections (EIA/TIA 568B colors shown):

7I52 PIN	7I52 SIGNAL	DIRECTION	CAT5 PIN	CAT5 568B COLOR
1,9,17	GND	FROM 7I52	4	BLUE
2,10,18	GND	FROM 7I52	5	BLUE / WHITE
3,11,19	RX+	TO 7I52	6	GREEN
4,12,20	RX-	TO 7I52	3	GREEN / WHITE
5,13,21	TX+	FROM 7I52	2	ORANGE
6,14,22	TX-	FROM 7I52	1	ORANGE / WHITE
7,15,23	+5V	FROM 7I52	7	BROWN / WHITE
8,16,24	+5V	FROM 7I52	8	BROWN

SPECIFICATIONS

	MIN	MAX	UNITS
5V POWER SUPPLY	4.75	5.25	VDC
5V POWER CONSUMPTION	---	400	mA
(all outputs loaded with 130 ohm terminations)			
(no external encoder or serial 5V load)			
5V CURRENT TO EACH I/O CONNECTOR	---	640	mA
MAXIMUM DATA RATE	---	10	MBIT/S
RS-422 INPUT COMMON MODE RANGE	-7	+12	Volts
RS-422 TERMINATION RESISTANCE	118	122	Ohm
RS-422 OUTPUT LOW	—	.8	Volts
(24 mA sink current)			
RS-422 OUTPUT HIGH	VCC-2.5	—	Volts
(24 mA source current)			
ENC INPUT COMMON MODE RANGE	-7	+12	Volts
ENC INPUT TTL MODE THRESHOLD	1.4	1.8	Volts
OPERATING TEMP.	0	+70	^{o}C
OPERATING TEMP. (-I version)	-40	+85	^{o}C
OPERATION HUMIDITY	0	95%	NON-COND

DRAWINGS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4.000
3.850
3.725
0.800
0.150
0.150
0.600
1.120
2.000
2.020
2.920
3.825
3.850
4.000
0.410
MESA 7I52
COM 3-5
COM 0-2
ENC 3-5
ENC 0-2
+5V
PIN 1
MESA
ART REV. B
P1
P2
P3
P4
P5
J1