Si86xx CMOS Digital Isolator-Based Serial Interface User's Guide

1. Introduction

SI86xx devices are CMOS-based galvanic isolators (1 kV/2.5 kV/5 kV) designed for industrial, commercial, and medical isolation applications. They are available in various channel counts (1/2/3/4/5/6), speeds (1 and 150 Mbps), and options in two package options (narrow and wide body SOIC). They are also available in unidirectional or bidirectional (I^2C) channels option.

2. Kit Contents

The Si86xxCOM Evaluation Board contains the following items:

- Si86xxCOM evaluation board show casing:
  - Si8642BB 4-channel unidirectional 1 Mbps digital isolator, narrow body, 2.5 kV
  - Si8621BB 2-channel unidirectional 150 Mbps digital isolator, narrow body, 2.5 kV
  - Si8622ED 2-channel unidirectional 1 Mbps digital isolator, wide body, 5 kV*

***Note:** The creepage and clearance are defined by the narrow-body SOIC (2.5 kV) isolators used in the EVB and must NOT be used for 5 kV isolation testing.

2.1. Hardware Overview

The Si86xxCOM Evaluation Board implements the isolated physical layer for RS232, RS422/485, and CAN bus serial transceivers. Key features include:

- Isolated RS232 transceiver: Maximum data rate of 1 Mbps. Isolated TXD, RXD, RTS, and CTS signals with DB9 connector interface.
- Isolated 4 Wire RS422/485: Maximum data rate of 52 Mbps; failsafe full duplex with passive flow control. DB9 and RJ45 connectors.
- Isolated CAN Bus: Maximum data rate of 1 Mbps, which implements the ISO 11898-3 physical layer and DB9 connector.

A top-level hardware block diagram is shown in Figure 1. The RS232 and RS422/RS485 isolated transceivers operate as a repeater, and the CAN Bus interface operates as an isolated controller-side interface.

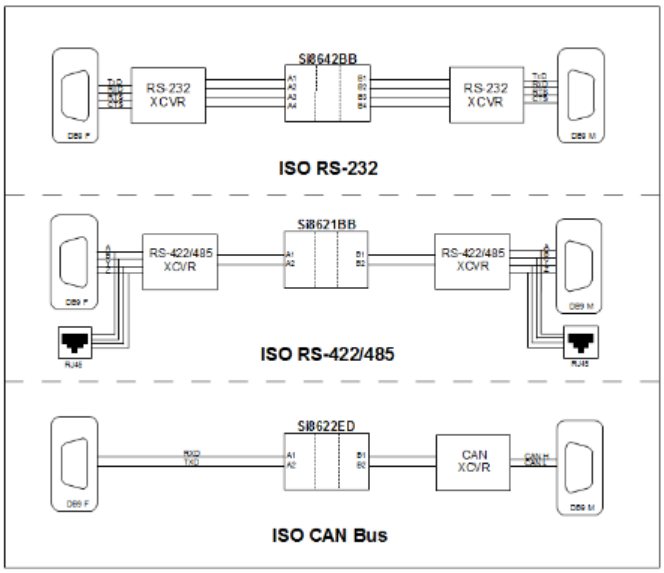

Figure 1. Top-Level Hardware Overview

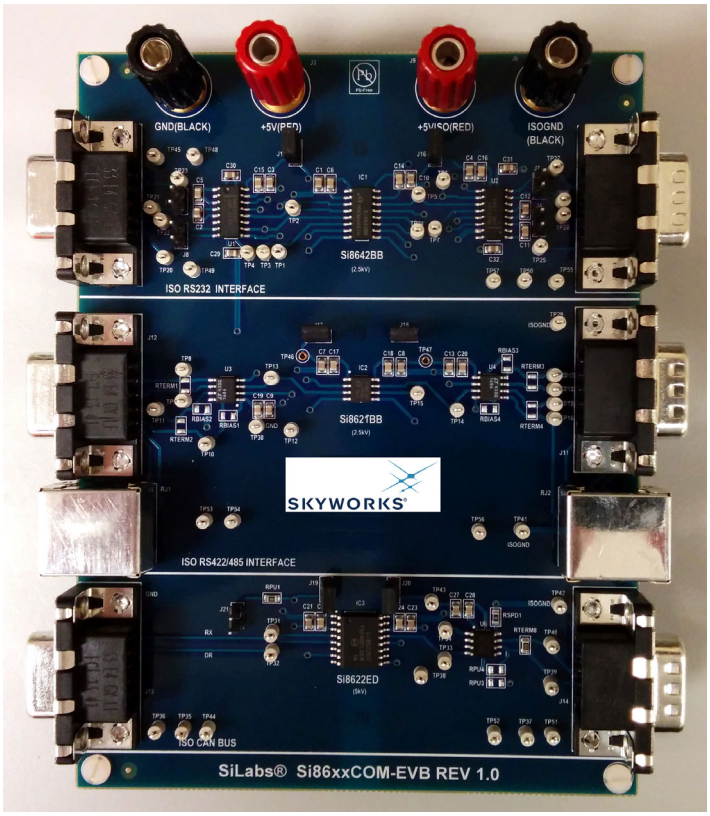

Figure 2. Si86xxCOM Evaluation Board

The evaluation board photo of Figure 2 shows the Skyworks Si86xx digital isolators placed at the center of the board. The RS232 and 422/485 isolated transceivers are implemented with narrow-body, 2.5 kV Si8642BB and Si8621BB digital isolators. The medical grade CAN bus interface is implemented with a wide-body Si8622ED digital isolator rated at 5 kV.*

***Note:** The creepage and clearance are defined by the narrow-body SOIC (2.5 kV) isolators used in the EVB and must NOT be used for 5 kV isolation testing.

3. Required Equipment

- Two dc power supplies (isolated)
- Two red and black banana-to-banana cables
- One straight-through RS232 cable (3'3, 2'2) (e.g. StarTech Model#MXT100_25)
- One crossover (null modem) RS232 cable (3'2, 2'3) (e.g. StarTech Model # SCNM9FM)
- One PC with COM1 port
- Si86xxCOM evaluation board (under test)
- Si86xxCOM User's Guide (this document)

3.1. Optional Equipment (User Can Test the Functionality of Standalone EVB Using the Following Equipment)

- One 4-channel oscilloscope, 250 MHz BW (e.g., TDS784A)
- Dual output Pattern/Function generator, 80 MHz data rate (e.g., Agilent 81104A)
- Two BNC to hook cable (e.g., Pomona #3788)

4. Hardware Overview and Demo

The Si86xxCOM evaluation board operates from 4.75 to 5.25 V. Each isolated interface is enabled or disabled by jumper option settings as shown in Figures 3, 4, and 5 (RS232, RS422/485 and CAN Bus isolated interfaces, respectively).

Refer to Figure 3:

- J3,J5Connector for +5 V bus (J3) and GND(J5) plane
- J9,J6Connector for +5VISO bus (J9) and ISOGND(J6) plane
- J15,J16Header 2x1, Supply for RS232 interface
- J1,J2DB9 Female (J1) and Male (J2) connector for RS232
- J4,J7,J8,J10Header 2x1, RS232 loopback test enable

Refer to Figure 4:

- J17, J18Header 2x1, Supply for RS422/485 interface
- J11,J12DB9 Female (J1) and Make (J2) connector for RS422/485
- RJ1,RJ2RJ45 connector for RS422/485

Refer to Figure 5:

- J19,J20Header 2x1, Supply for CAN Bus interface
- J13,J14DB9 Female (J13) and Male (J14) connector for CAN bus

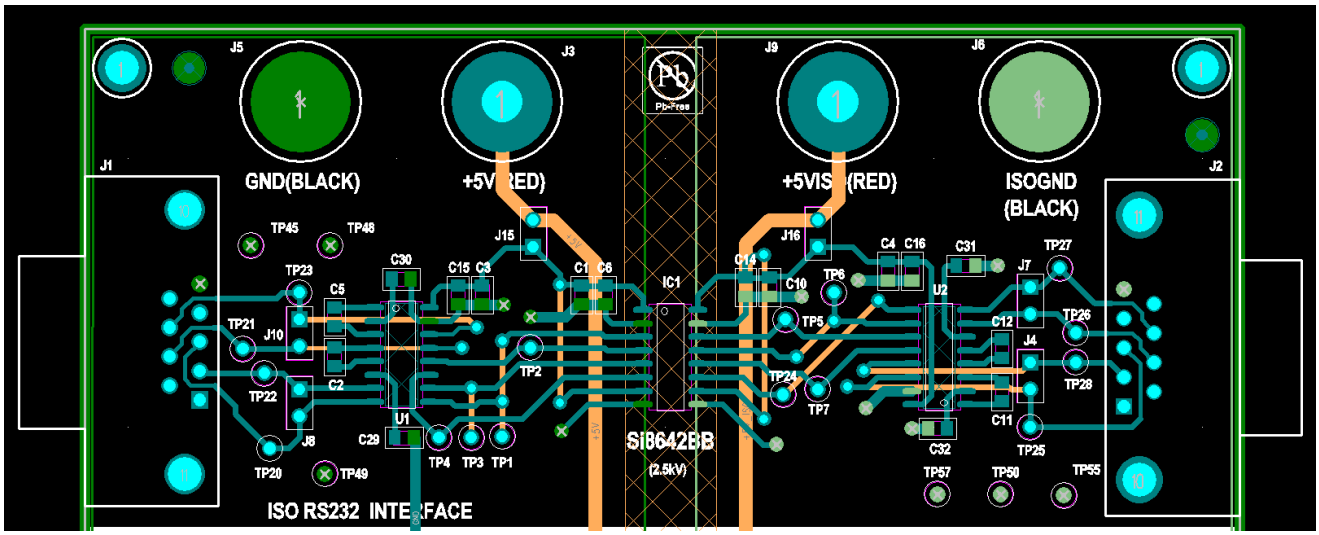

Figure 3. Power Supply Input and Isolated RS232 Interface

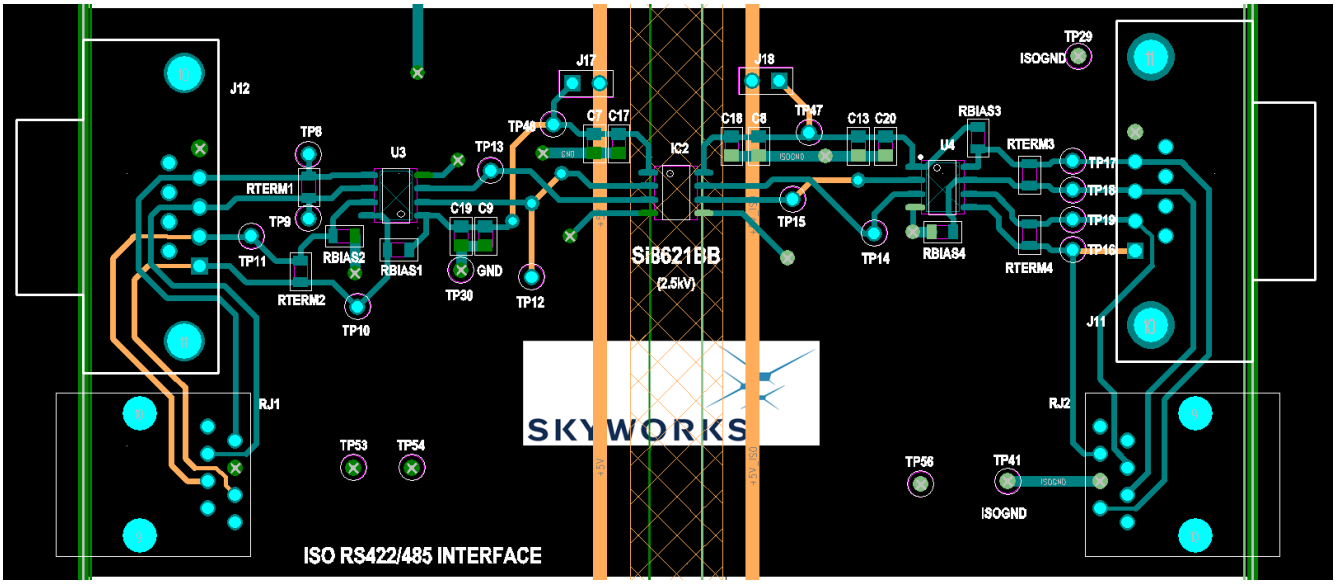

Figure 4. Isolated 4-Wire R422/485 Interface

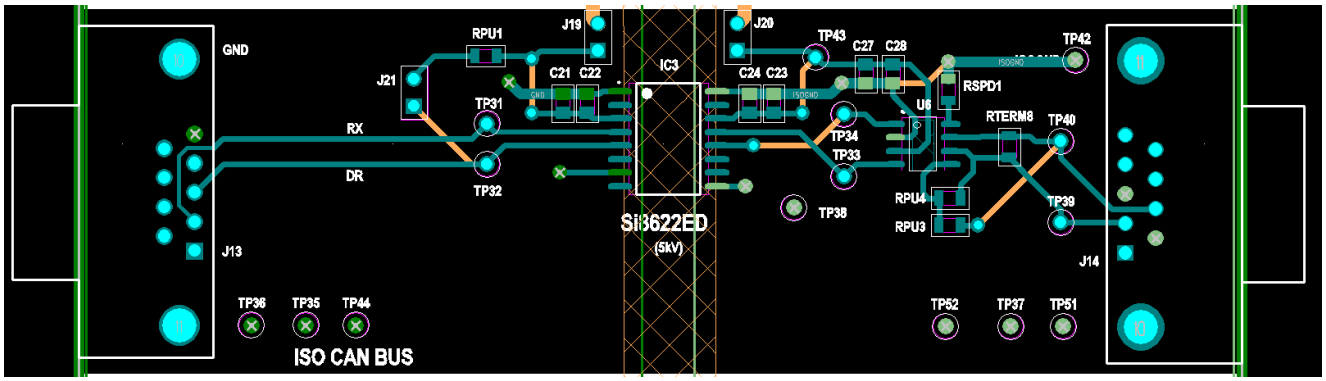

Figure 5. Isolated CAN Bus Interface

4.1. Common Board Setup

Perform the following steps for a common board setup:

1. Turn on the dc power supplies, and set the output voltage to 5.0 V, 500 mA current limit.
2. Connect red banana cables to each of the positive outputs of the power supply, and connect the black banana cables to the respective negative or 0 V output.
3. Turn off the dc power supply.
4. Connect the other end of one of the red banana cables to J3 (+5 V) and the other end of the second red banana cable to J9 (+5VISO).
5. Connect the other end of the black banana cable to J5 (GND) and J6 (ISOGND), respectively.

This completes the power supply connections to the board.

4.2. Isolated RS232 interface Setup

Perform the following steps for an isolated RS232 interface setup:

1. Power up a PC with the COM1 port (Male DB9 connector).
2. Connect one end of the straight-through RS232 cable to the COM1 port and the other end to J1 of the evaluation board. Table 1 lists the standard pin definitions of the interface.

Table 1. Isolated RS232 Pin Definitions

J1 DB9 (Female) Pinout	RS232 Signal Name	J2 DB9 (Male) Pinout
1,4,6,9	NC	1,4,6,9
2	RXD	2
3	TXD	3
5	GND	5
7	RTS	7
8	CTS	8

3. On the J2 side, use straight-through cable when connecting to DCE (Modem) and crossover cable when connecting to DTE (PC, printers, PLCs etc). Refer to Figures 6 and 7.
4. Shunt jumpers J15 and J16 to apply power to the circuit.
5. Turn ON the dc power supply.

The board under test is ready to transfer data.*

***Note:** Most PCs support data rates up to 115 kbps, but the onboard transceiver and isolator can support a maximum data rate of 1 Mbps.

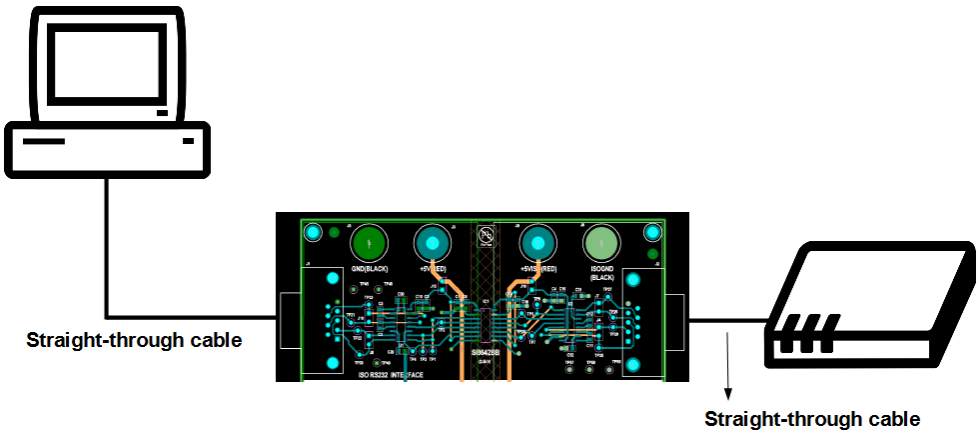

Figure 6. DTE to DCE Connection

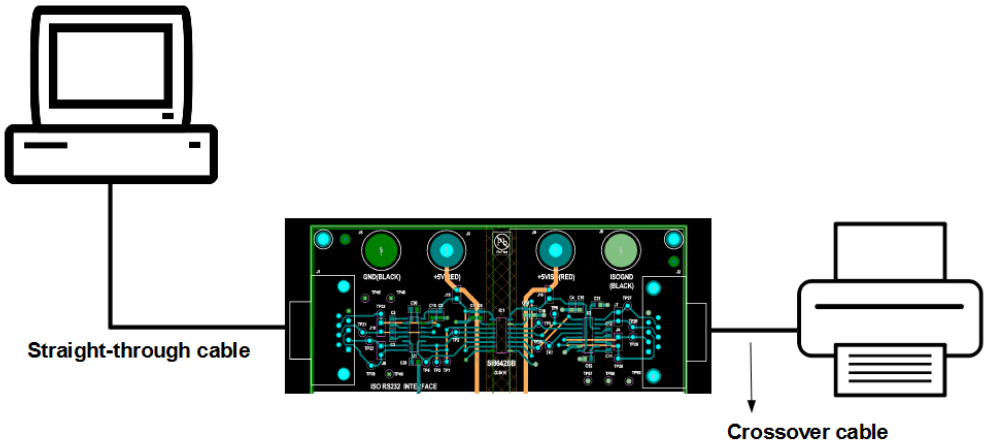

Figure 7. DTE to DTE Connection

4.3. Isolated RS422/485 Interface Setup

The RS422 and RS485 standards are based on a balanced differential line. The RS422 interface is typically implemented as a 4-wire, point-to-point communication system, whereas RS485 can be implemented in a 2-wire or 4-wire multipoint configuration.

Note: This EVB implements a full-duplex, isolated 4-wire RS422/RS485 interface with automatic flow control and should NOT be used to implement a 2-wire interface

Please note that the RS422/485 standard does not recommend a specific connector or pinout like the RS232 standard. In light of this, the EVB has DB9 and 8-pin-RJ45 connectors for flexibility, allowing the user to choose and follow the pinout definition table for proper cabling.

Proper termination is required at each end of the cable for reliable communication links and long wiring runs. The EVB has place holders (RTERM1-4) for termination resistors to match the characteristic impedance of the cable specified by the manufacturer. A typical value is around 120 Ω. The RS422/RS485 transceivers used in the EVB have 22 kΩ receiver input resistance and a fail-safe feature that guarantees the receiver output HIGH when inputs are left open or shorted.

Perform the following steps for interface setup:

1. Turn off the dc power supplies (if they are not turned off already).
2. Shunt jumpers J17 and J18 to apply power to the circuit.
3. Refer to Table 2 for the RS422/485 connector pinout definition. Make sure the cable is made to this pinout definition.
4. Recommended cables are 24 AWG 2 twisted pair with shield (e.g., Belden 9842-500).
5. A simple 4-wire master slave point-to-point connection is shown in Figure 8 for reference.
   - Connect the transmitter output of the master node to the receiver input (J12.1 and J12.2) of the EVB board. Connect the transmitter output (J12.3 and J12.4) of the EVB to the receiver input of the master node.
   - Connect the isolated transmitter output (J11.1 and J11.2) of the EVB board to the receiver input of the slave node. Connect the transmitter output of the slave node to the isolated receiver input (J11.4 and J11.3) of the EVB.
6. Turn on the dc power supply.
7. The EVB is ready for data transfer and can support a maximum data rate of 52 Mbps.

Table 2. RS422/485 Pinout Definition for DB9 and RJ45 Connector

J12 (Female DB9) Pinout	RS422/485 Signal Name	J11 (Male DB9) Pinout	RS422/485 Signal Name
1	A (RxD+)	1	Y(TxD+)
2	B (RxD–)	2	Z(TxD–)
3	Z (TxD–)	3	B(RxD–)
4	Y (TxD+)	4	A(RxD+)
5	GND	5	GND
6,7,8,9	NC	6,7,8,9	NC
RJ1 Pinout	**RS422/485 Signal Name**	**RJ2 Pinout**	**RS422/485 Signal Name**
1,7,8	NC	1,7,8	NC
2	Y (TxD+)	2	A (RxD+)
3	Z (TxD–)	3	B(RxD–)
4	GND	4	GND
5	B (RxD–)	5	Z (TxD–)
6	A (RxD+)	6	Y (TxD+)

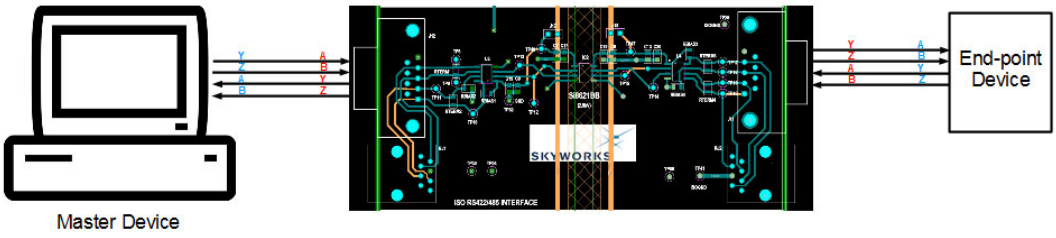

Figure 8. Simple Point-to-Point RS422/485 Connection

4.4. Isolated CAN Bus Interface Setup

CAN (Controller Area Network) Bus is a bidirectional, 2-wire (CANH and CANL) differential signaling bus with a data rate up to 1 Mbps. The CAN bus signal has two states: recessive (logic High) and dominant (logic Low). When no driver is active, the bus is in the recessive state (CANH=CANL). The non-bus side of the transceiver is connected to a controller. The EVB implements an isolated controller-side CAN interface as shown in Figure 1. The speed/slope control resistor RSPD is tied to GND for high-speed (1 Mbps) operation. Users can increase the value of resistor RSPD for slower operation.

The CAN bus must be properly terminated at each end of the cable. The EVB comes with a standard termination of 120 Ω (RTERM8) installed. The Si8622ED digital isolator powers up with default high output making sure the CAN bus is in a recessive state.

Perform the following steps for interface setup:

1. Turn the power supply off, if it is not off already.
2. Shunt jumpers J19 and J20 to apply power to the circuit.
3. Standard twisted pair (24 AWG, ex HYCANBUS0901) with or without shield can be used. Refer to Table 3 for pinout definition. Make sure the cable is made to this pinout definition.
4. A typical connection to the EVB is shown in Figure 9.
   - Connect the controller side driver output and receiver input to the J13.3 (DR) and J13.2 (RX) pins of EVB respectively.
   - Connect the CANH (J14.7) and CANL (J14.2) of the EVB to the bus lines.
5. Turn on the dc power supply.

The EVB is ready for data transfer and can support a maximum data rate of 1 Mbps.

Table 3. CAN Bus Interface Pinout Definition

J13 (Female DB9) Pinout	CAN Bus Signal Name	J14 (Male DB9) Pinout	CAN Bus Signal Name
1,4,6,7,8,9	NC	1,4,5,6,8,9	NC
2	RX (Receiver Output)	2	CANL
3	DR (Driver Input)	3,6	GND
5	GND	7	CANH

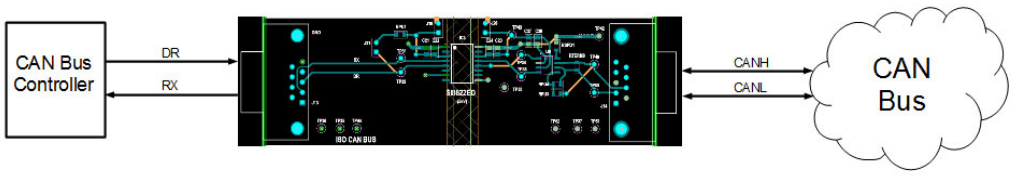

Figure 9. Isolated CAN Bus Interface Connection

5. Schematics

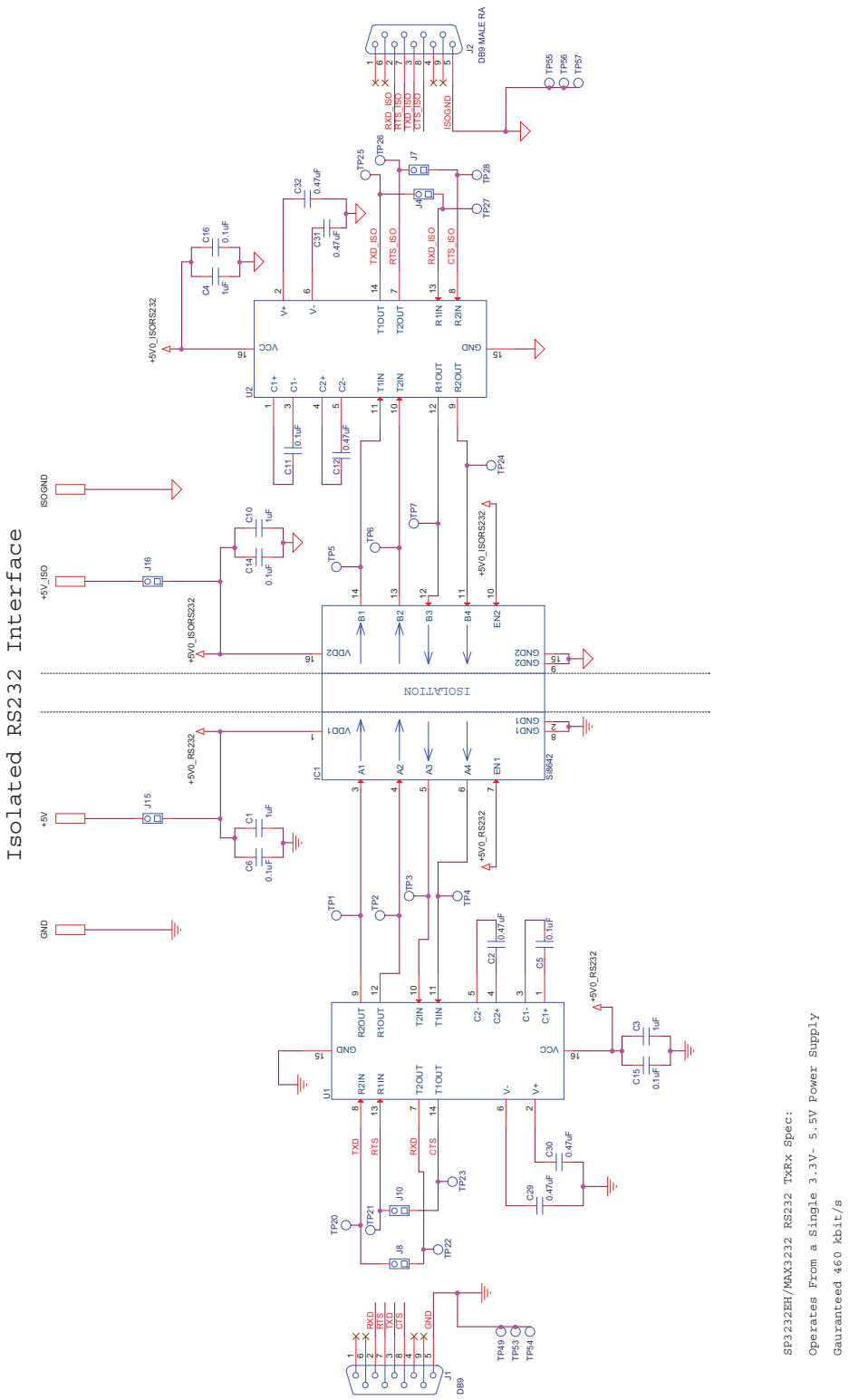

Figure 10. Isolated RS232 Interface Schematic

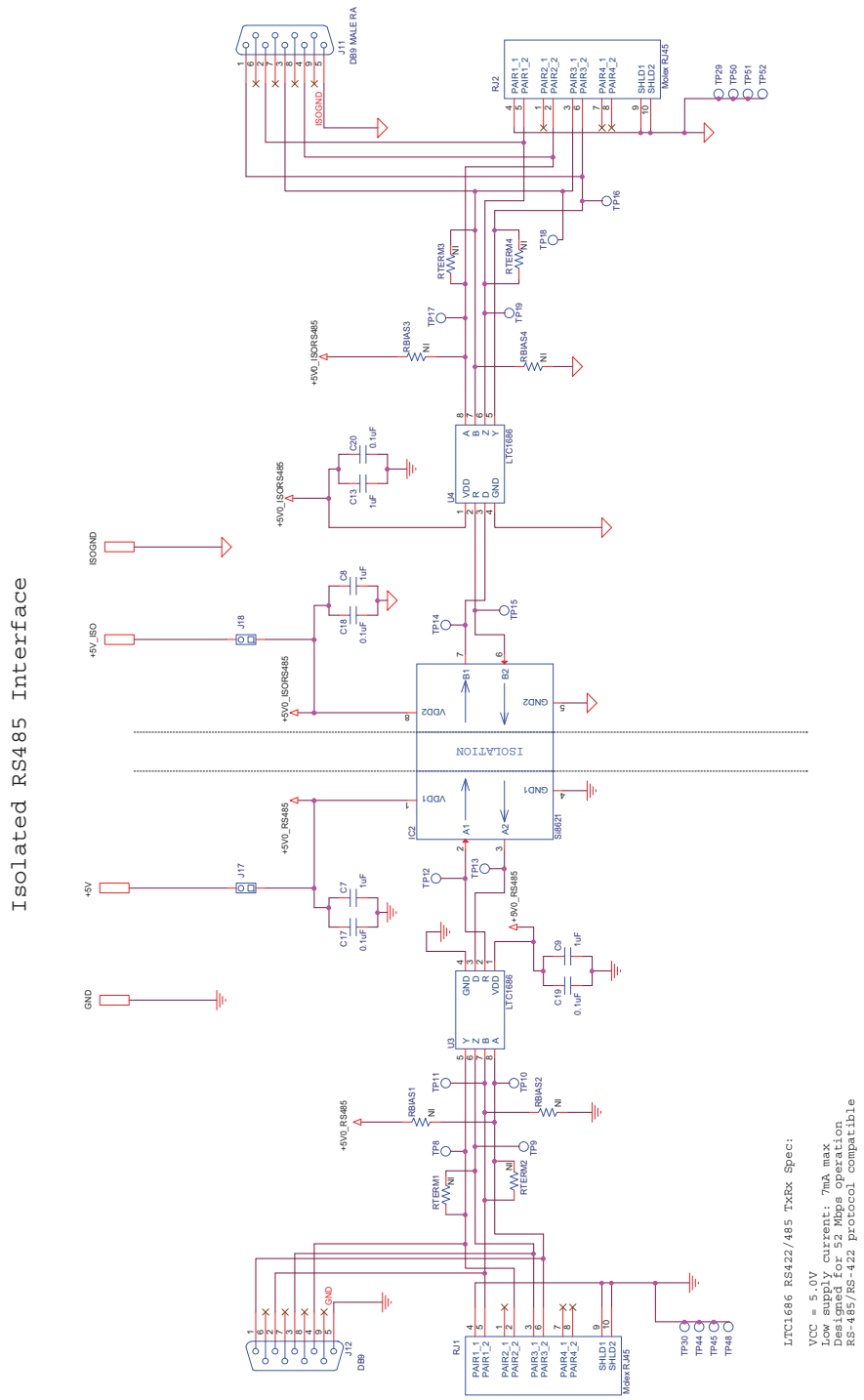

Figure 11. Isolated RS422/485 Interface Schematic

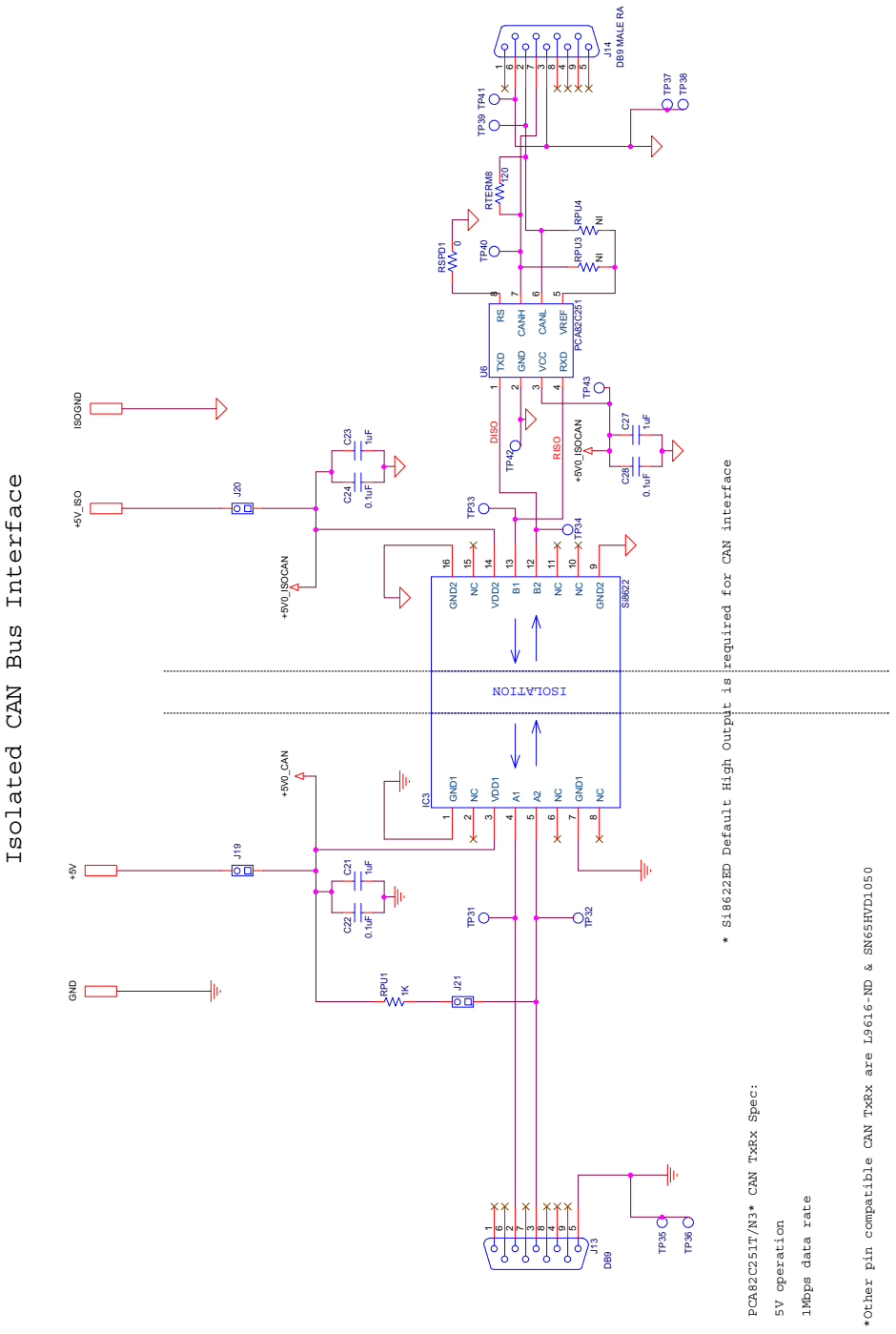

Figure 12. Isolated CAN bus Interface Schematic

6. Si86xxCOM Bill Of Materials

Table 4. Si86xxCom Bill of Materials

Quantity	Reference	Value	Voltage	Tolerance	Type	ManufacturerPN	Manufacturer
11	C1, C3, C4, C7, C8, C9, C10, C13, C21, C23, C27	1 µF	16 V	±20%	X7R	C0805X7R160-105M	Venkel
6	C2, C12, C29, C30, C31, C32	0.47 µF	16 V	±10%	X7R	C0805X7R160-474K	Venkel
13	C5, C6, C11, C14, C15, C16, C17, C18, C19, C20, C22, C24, C28	0.1 µF	16 V	±10%	X7R	C0805X7R160-104K	Venkel
1	IC1	Si8642			Isolator	Si8642BB-B-IS1	Skyworks
1	IC2	Si8621			Isolator	Si8621BB-B-IS	Skyworks
1	IC3	Si8622			Isolator	Si8622ED-B-IS	Skyworks
3	J1, J12, J13	DB9			D-SUB	D09S33E4GX00LF	FCI
3	J2, J11, J14	DB9 MALE RA			D-SUB	D09P33E4GX00LF	FCI
2	J3, J9	RED			BANANA	111-0702-001	Johnson/ Emerson
11	J4, J7, J8, J10, J15, J16, J17, J18, J19, J20, J21	JUMPER			Header	TSW-102-07-T-S	Samtec
2	J5, J6	BLACK			BANANA	111-0703-001	Johnson/ Emerson
4	MH1, MH2, MH3, MH4	4-40			HDW	NSS-4-4-01	Richco Plastic Co
1	PCB1	Si86xx-COM-EVB REV 1.0			PCB	Si86xxCOM-EVB REV 1.0	Skyworks
2	RJ1, RJ2	Molex RJ45			Connector	85505-5113	Molex
1	RPU1	1K		±1%	ThickFilm	CR0805-10W-1001F	Venkel
1	RSPD	0			ThickFilm	CR0805-10W-000	Venkel
1	RTERM8	120		±1%	ThickFilm	CR0805-10W-1200F	Venkel
4	SO1, SO2, SO3, SO4	STAND-OFF			HDW	1902D	Keystone Electronics

Table 4. Si86xxCom Bill of Materials (Continued)

Quantity	Reference	Value	Voltage	Tolerance	Type	ManufacturerPN	Manufacturer
55	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28, TP29, TP30, TP31, TP32, TP33, TP34, TP35, TP36, TP37, TP38, TP39, TP40, TP41, TP42, TP43, TP44, TP45, TP48, TP49, TP50, TP51, TP52, TP53, TP54, TP55, TP56, TP57	WHITE			Loop	151-201-RC	Kobiconn
2	U1, U2	MAX3232	5.5 V		RS232	MAX3232CSE+	Maxim
1	U2	PCA82C251			CAN Bus	PCA82C251T	NXP
2	U3, U4	LTC1686				LTC1686CS8	Linear Tech
Not Installed							
10	RBIAS1, RBIAS2, RBIAS3, RBIAS4, RPU3, RPU4, RTERM1, RTERM2, RTERM3, RTERM4	0			ThickFilm	CR0805-10W-000	Venkel

7. Ordering Guide

Table 5. Ordering Guide

Ordering Part Number	Description
Si86xxCOM-RD	Isolated serial communication evaluation board

NOTES:

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