

HVAC Platform V1.1 User Guide

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1 Overview

This document describes the basic steps for getting started with Freescale's HVAC Platform V1.1 demo, and the basic board function is explained.

2 Introduction

Automotive heating, ventilation, and air conditioning (HVAC) systems are based on inputs from a variety of sensors, controlling different types of motors such as stepper/DC motors for flaps and DC/BLDC motors for blowers.

Through the innovative combination of microcontroller (S12G family) and analog devices (MC33905, MC33932, MC33937), this Freescale automotive HVAC control platform reference design is able to drive three types of motors (sensorless BLDC, DC, and stepper) for automotive HVAC applications.

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Demo board features

Leveraging the ultra low power of microcontrollers, and a scalable automatic climate control software algorithm, the reference design provides an ideal solution for saving energy, helping to make the world greener.

The HVAC control platform reference design mainly consists of a central control board with a human-machine interface, motor control board, and motors. It implements all the basic functions of an automotive HVAC. The sensing functions for temperature, light, humidity, and air quality enable people to control the vehicle climate in a more efficient way.

Moreover, the LCD in the reference design, controlled by a microcontroller (S08LG, optional), can display rich content including date, temperature, wind speed, etc., adding a significant level of convenience for the vehicle's occupants.

This reference design aims at shortening time to market for customers and partners, and it can be tailored to a customer's unique needs in an HVAC system, such as motor type and quantity, display (or lack of display), climate control algorithms, and so on. In addition, it is extensible by connecting an external touch-key or touch-screen board.

3 Demo board features

The HVAC Platform V1.1 includes these features:

- Three types of motor control
 - Sensorless BLDC
 - DC
 - Step motor
- Automatic climate control
- Multiple temperature zones supported
- Ultra-low-power mode, with wakeup by human-machine-interface or LIN/CAN bus
- CAN and LIN communication interfaces
- 3 × 3 matrix keypad and two knob inputs
- 4 × 37 segment LCD and adjustable backlight
- Support of interface to sensors
 - Temperature
 - Light
 - Humidity
 - Air quality
- Two logic relay interfaces to compressor and defrost
- Real time clock and date display and adjustment for calendar
- Extensible with touch-key board or touch-screen board
- Suitable for both 12 V and 24 V HVAC systems

4 Demo board application block diagram

The block diagram of the design is found in [Figure 1](#) and [Figure 2](#).

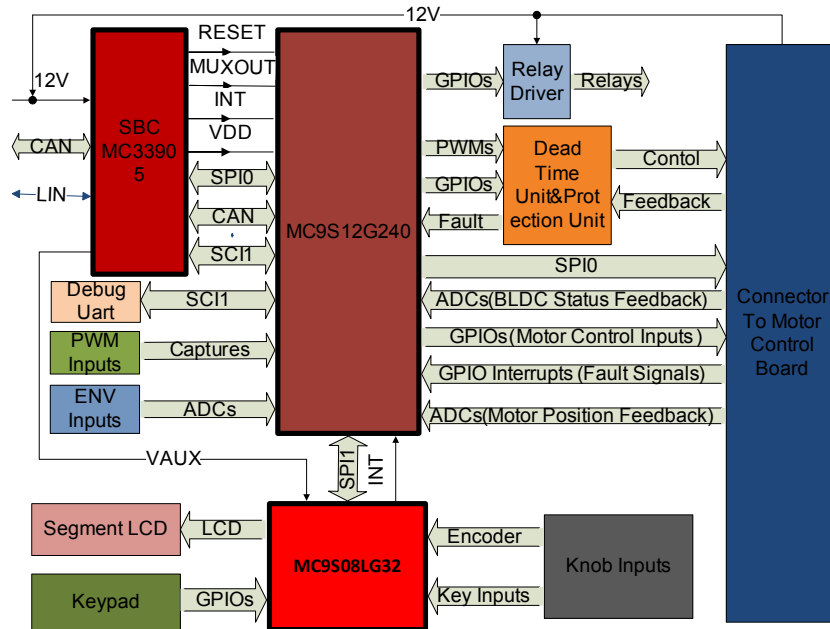


Figure 1. HVAC platform central control board block diagram

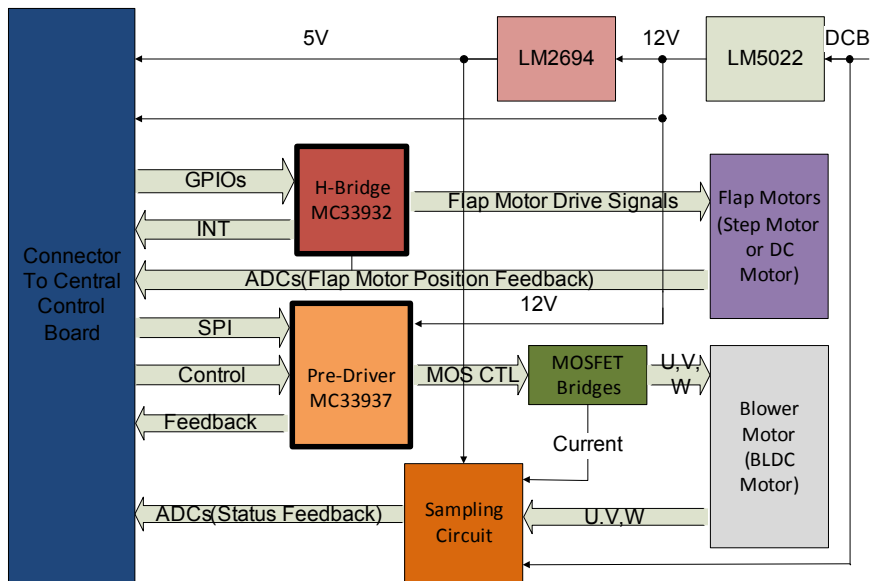


Figure 2. HVAC platform power board block diagram

5 Demo board views

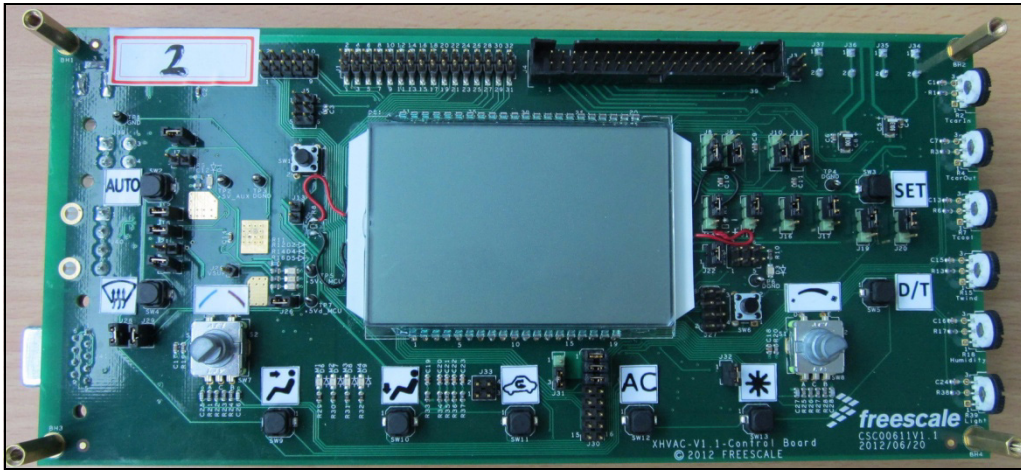


Figure 3. HVAC platform control board top view

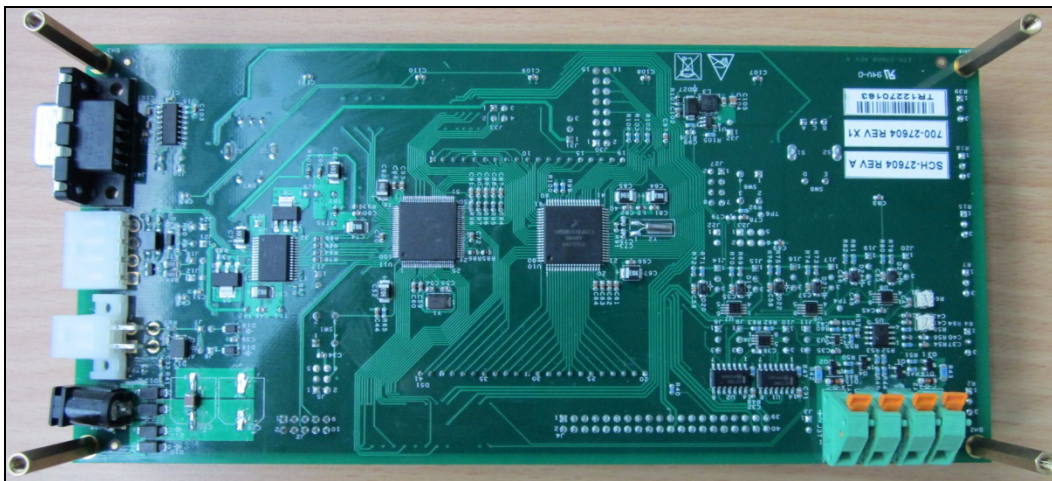


Figure 4. HVAC platform control board bottom view

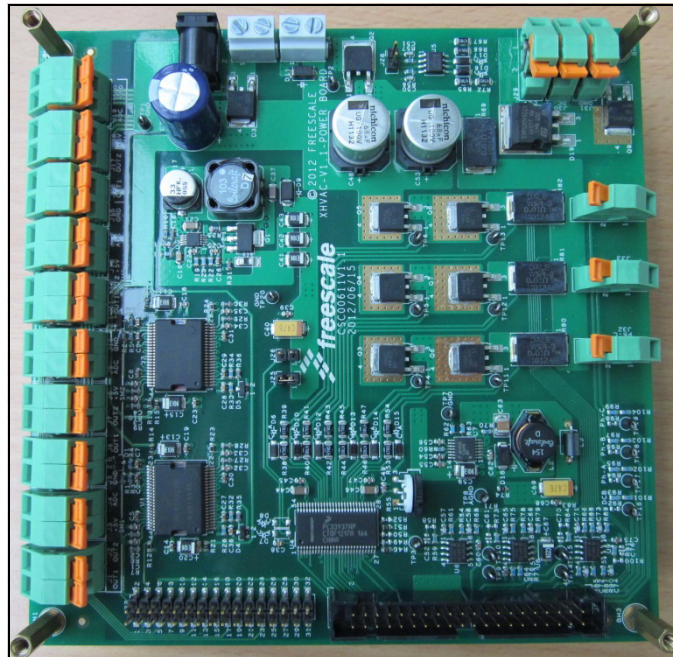


Figure 5. HVAC platform power board top view

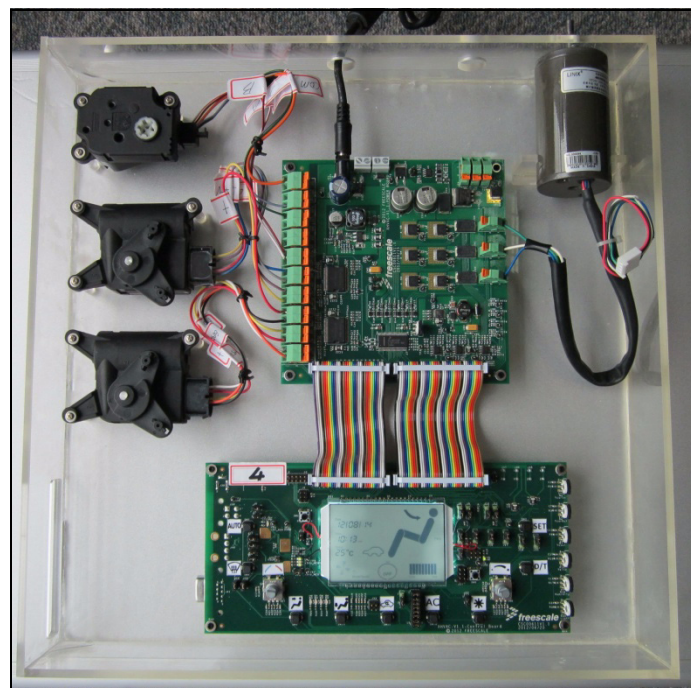


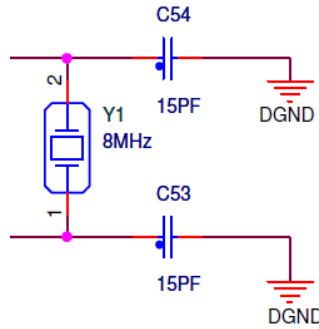
Figure 6. HVAC platform demo

6 HVAC platform demo board

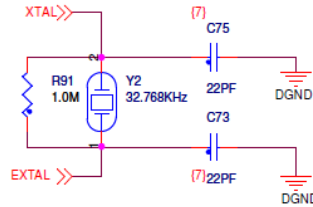
6.1 Getting started with HVAC central control board

6.1.1 Clocking

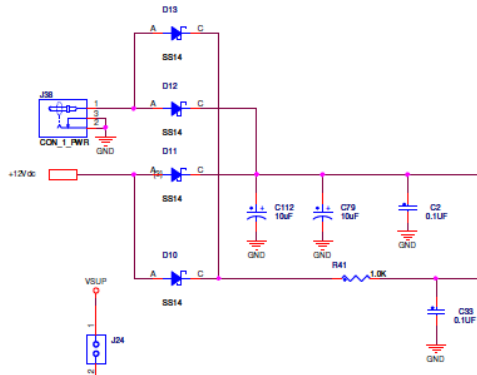
The S12G240 system uses an external 8 MHz crystal.



The LG32 system uses a 32.768 kHz crystal or an internal oscillator.



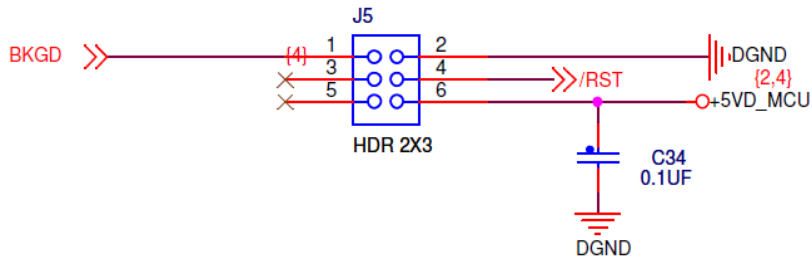
6.1.2 System power



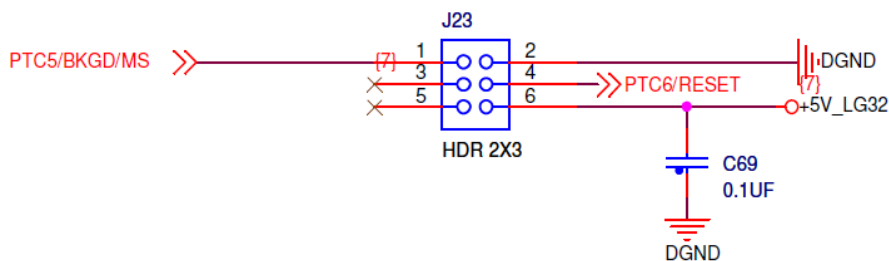
System power for the central control board can be an AC adaptor inserted from J38 or +12 V DC supplied from the motor control board through J4 on the central control board.

6.1.3 Debug interface

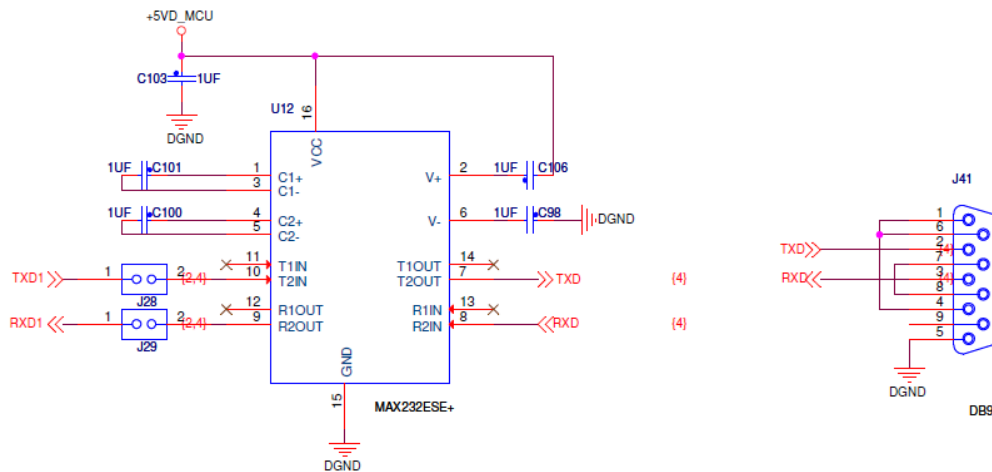
J5 is the BDM header used for debugging S12G240.



J23 is the BDM header used for debugging LG32.



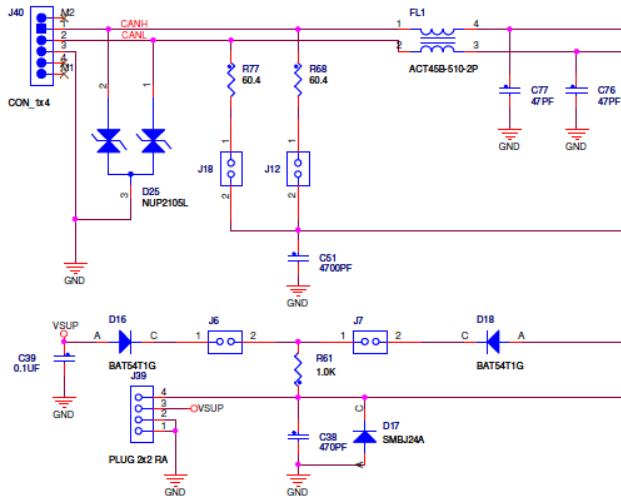
6.1.4 RS-232 interface



UART signals can be wired out for transferring to RS-232 signals for debugging.

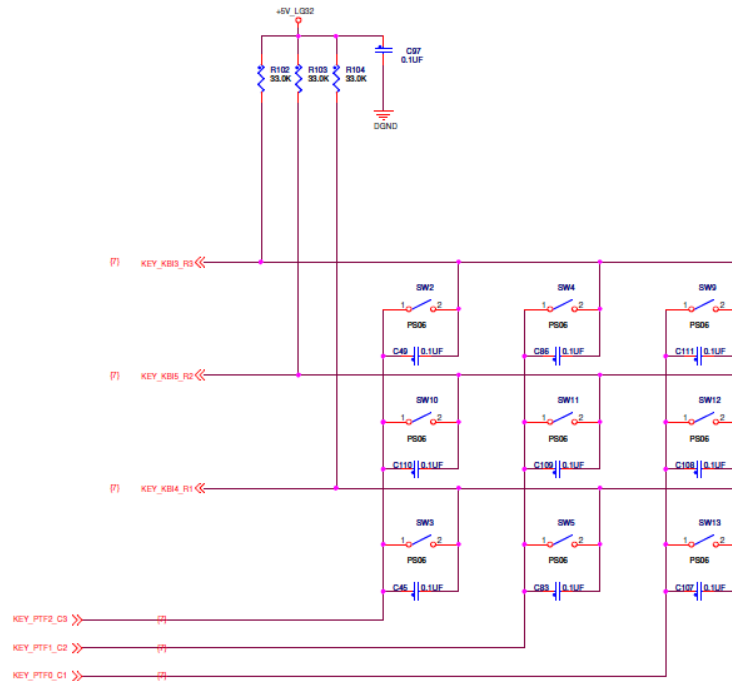
If UART signals are not used, they can be used for LIN interface communication.

6.1.5 CAN/LIN interface



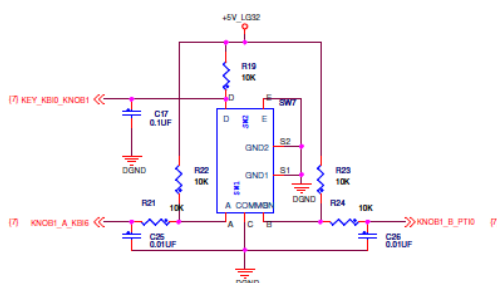
The CAN interface can be set in split mode. The LIN interface can select an internal or external 1 kΩ pullup to VSUP.

6.1.6 Key matrix 3×3



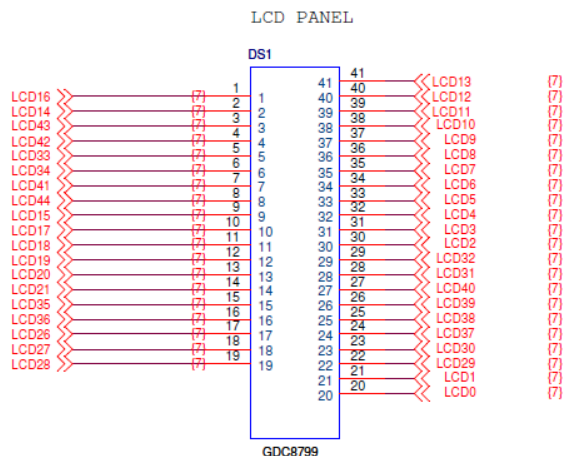
Key matrix 3×3 can be input to MCU signals (3 GPIO with interrupt function, another 3 GPIO without interrupt function).

6.1.7 Encoder



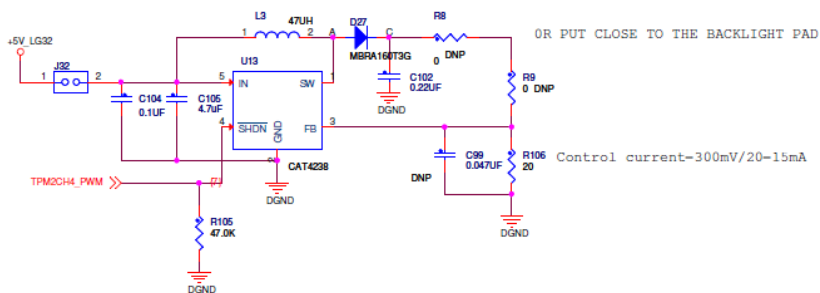
There are two encoder inputs on the central control board. The encoder has two PWM outputs while switching. There is also one additional key on the encoder.

6.1.8 Segment LCD



The segment LCD can be driven directly from LG32.

6.1.9 Backlight control



The backlight is a 6 serial LED which can be driven from the CAT4238 output. The backlight intensity can be adjusted by changing the PWM ratio.

6.1.10 Jumper table

Table 1. Jumper settings

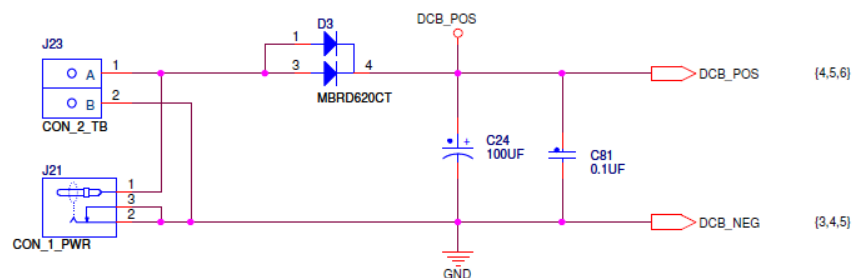
Jumper	Option	Setting	Description
J24	MC33905 Debug mode selection	1–2	Set MC33905 to Debug mode
J21	MC33905 Safe mode selection	1–2	Set MC33905 to Safe mode
J18	CAN bus mode selection	1–2	Set CAN bus to Split mode
J12	CAN bus mode selection	1–2	Set CAN bus to Split mode
J6	Lin bus pullup selection	1–2	Set LIN bus external pullup
J7	Lin bus pullup selection	1–2	Set LIN bus internal pullup
J26	VDD power supply	1–2	VDD supplied from MC33905
J13	Reset signal to MCU	1–2	MC33905 reset signal to MCU
J3	VDD power supply	1–2	VDD supplied from motor control board
J31	LG32 power supply option	1–2	Select 5 V Aux FROM MC33905
		2–3	Select 5 V main from MC33905
J28	UART signal selection	1–2	Select MCU TXD output
J29	UART signal selection	1–2	Select MCU RXD input
J15	PWMA dead time unit selection	1–2	Ignored hardware dead time
		2–3	Set hardware dead time
J14	PWMA dead time unit selection	1–2	Ignored hardware dead time
		2–3	Set hardware dead time
J17	PWMB dead time unit selection	1–2	Ignored hardware dead time
		2–3	Set hardware dead time
J16	PWMB dead time unit selection	1–2	Ignored hardware dead time
		2–3	Set hardware dead time
J20	PWMC dead time unit selection	1–2	Ignored hardware dead time
		2–3	Set hardware dead time
J19	PWMC dead time unit selection	1–2	Ignored hardware dead time
		2–3	Set hardware dead time
J8	RS trigger input selection	1–2	Set protection output as RS trigger input
		2–3	Set GND as RS trigger input

Table 1. Jumper settings (continued)

Jumper	Option	Setting	Description
J10	MC33937 predriver enable selection	1–2	Ignore RS trigger output as enable input
		2–3	Set RS trigger output as enable input
J9	Backlight driver enable	1–2	Backlight driver supply enabled or not
J22	VLL3 supply selection	1–2	External voltage selected for VLL3

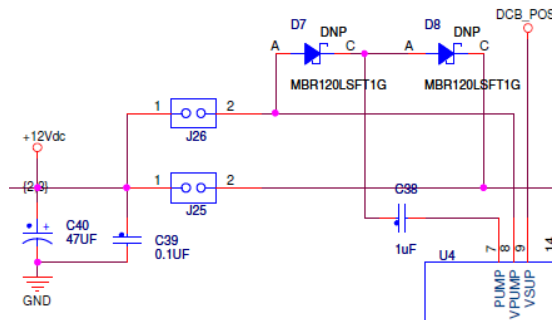
6.2 Getting started with the HVAC motor control board

6.2.1 Motor control board power supply



J23 and J24 are the motor control board power supply interface. Either of them can be used for the power supply.

6.2.2 MC33937 power supply

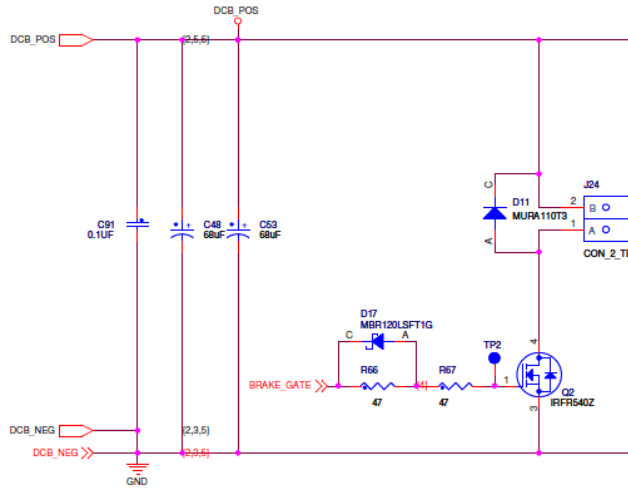


MC33937 acts as an amplifier of the MCU PWM signal to drive the three-phase inverter of the BLDC.

The MC33937 can be powered by a 12 V power supply which is configurable via J25. The charge pump supply can be powered via J26.

By default, short J25 pin1 and pin 2, and do not short J26 pin1 and pin2.

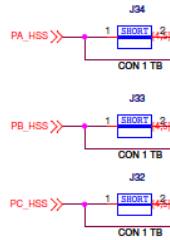
6.2.3 DC-bus braking resistors



J24 can be connected by dynamic braking resistors. If DC-bus voltage is very high, the brake gate supplies a high level to the Q2 MOSFET. The current bypasses the braking resistor and Q2 and DC-bus voltage are reduced.

By default, dynamic braking resistors are not installed on J24.

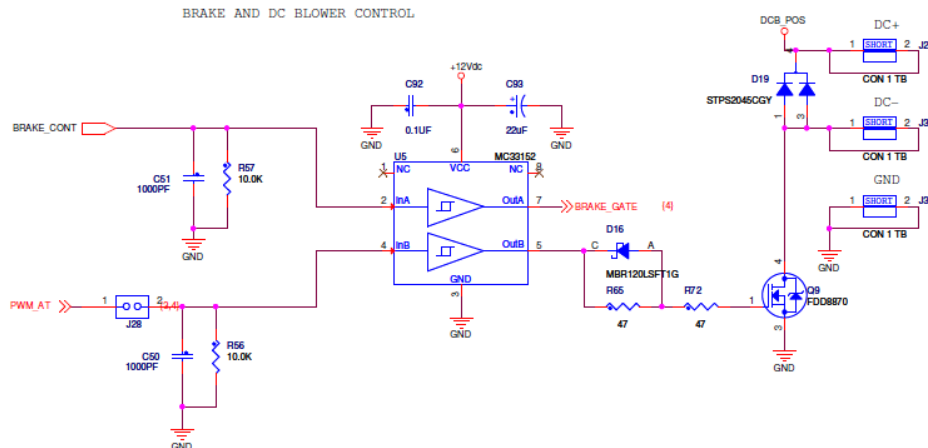
6.2.4 BLDC three-phase drive port



J32, J33, and J34 are the BLDC three-phase drive port:

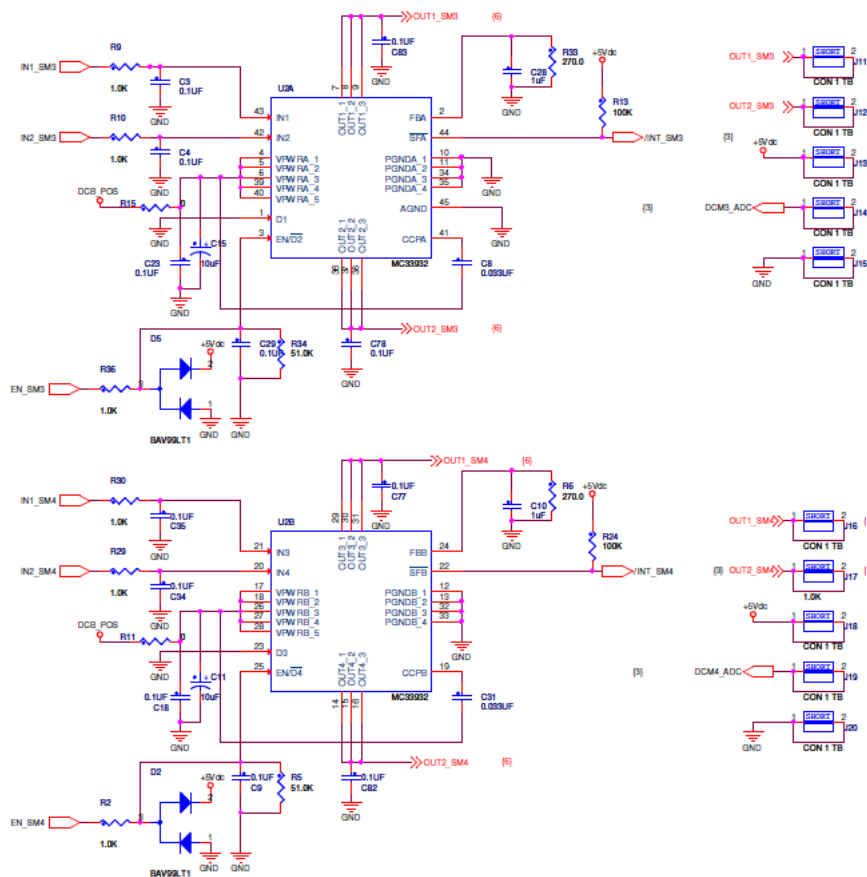
- J32 corresponds to phase C of the inverter.
- J33 corresponds to phase B of the inverter.
- J34 corresponds to phase A of the inverter.

6.2.5 DC blower control port



J29, J30, and J31 are the DC motor drive port.

6.2.6 Stepper control port



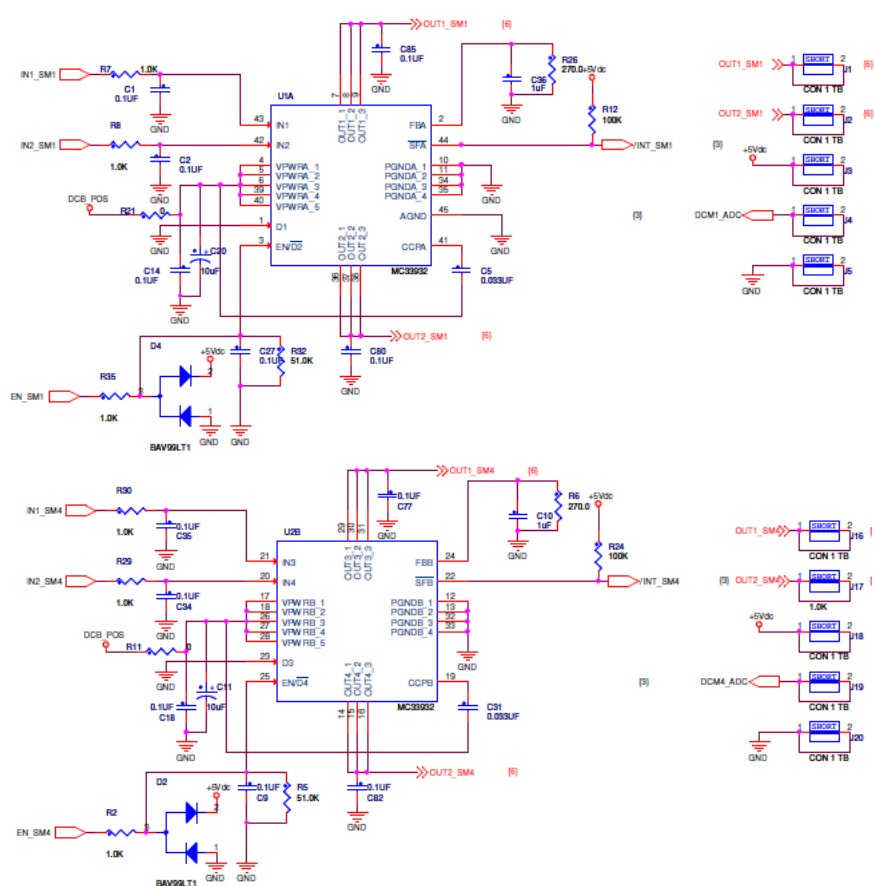
The stepper motor is a two-phase, four-wire type.

J11, J12, J16, J17, and J20 control the stepper motor:

HVAC platform demo board

- J11 corresponds to A phase.
- J12 corresponds to B phase.
- J16 corresponds to C phase.
- J17 corresponds to D phase.
- J20 is GND.

6.2.7 Servo motor control port

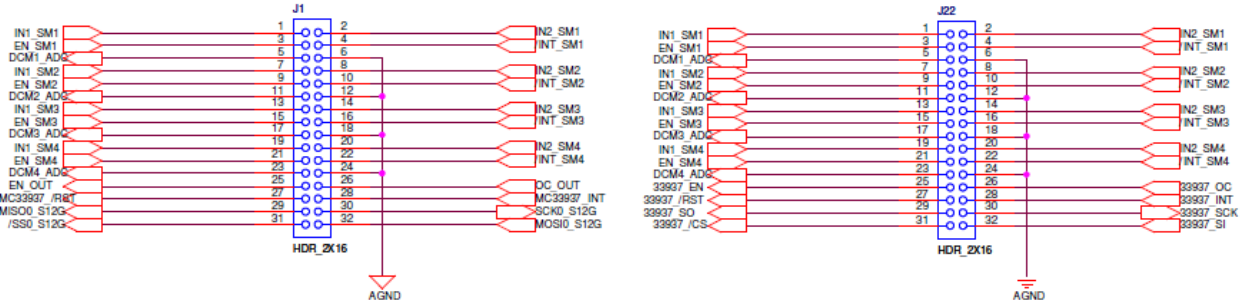


As pictured above, J1, J2, J3, J4, and J5 control one stepper motor. J6, J7, J8, J9, and J10 control another stepper motor.

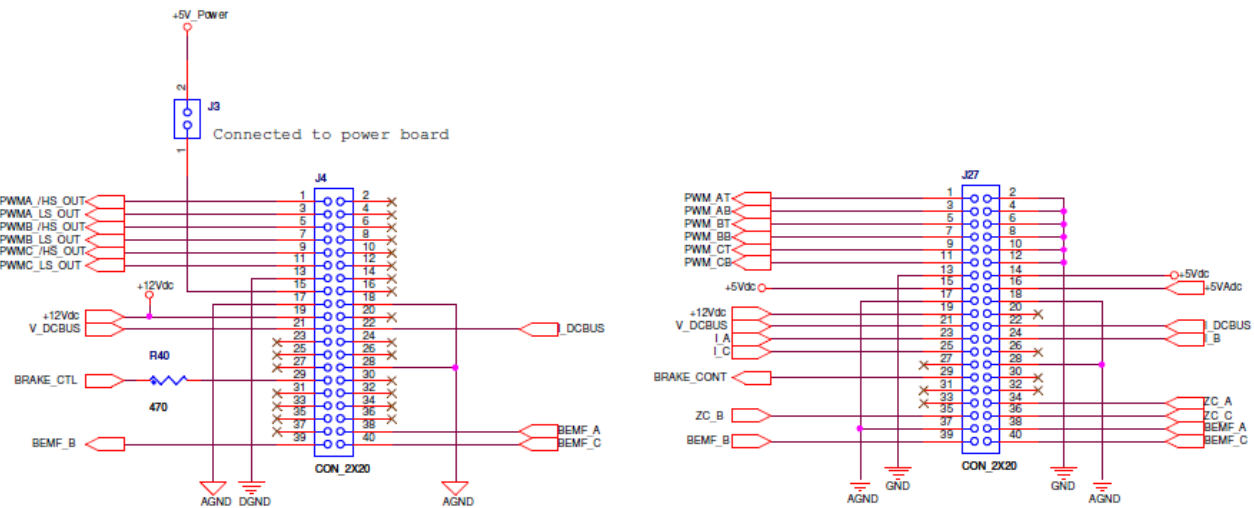
6.3 Getting started with the HVAC platform

6.3.1 Connecting the central control board with the motor control board

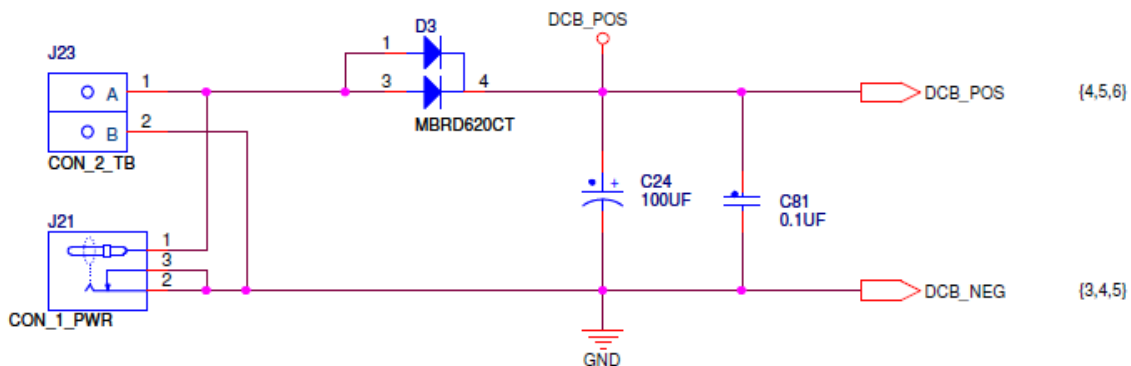
J1 of the central control board corresponds to J22 of the motor control board.



J4 of the central control board corresponds to J27 of the motor control board.



6.3.2 Powering up the HVAC platform through the power supply of the motor control board



J23 and J24 are the motor control board power supply interface.

Conclusions

Powering up J23 or J24 will supply power to both motor control board and central control board.

7 Conclusions

This document describes the basic steps for getting started with Freescale's HVAC platform demo boards and the demo suitcase. For technical details about the board design and solution implemented, please go to www.freescale.com.

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