DRV11873 Evaluation Module

This document is provided with the DRV11873 customer evaluation module (EVM) as a supplement to the DRV11873 datasheet (SLWS237). It details the hardware implementation of the EVM.

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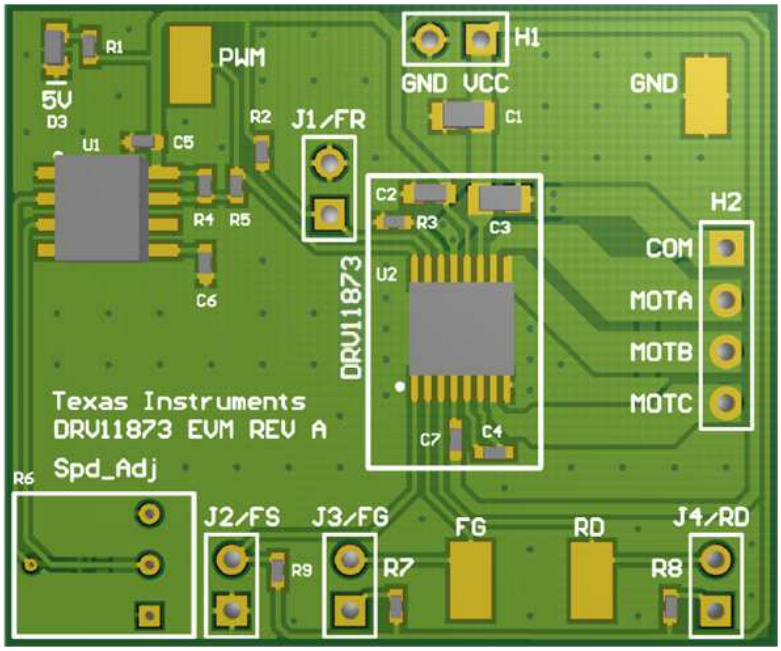

2 Introduction

The DRV11873EVM is a complete solution for evaluating the DRV11873 12-V, three-phase, sensorless BLDC motor driver. It includes a TLC555 timer configured to supply a PWM to the DRV11873, a potentiometer to adjust the speed of the motor by varying the duty cycle of the PWM, a jumper on the FG pin to allow the use of an external pull-up resistor, and a jumper on the RD pin to indicate that the motor has entered a lock protection state. The DRV11873EVM also has a jumper on the FR pin to select forward or reverse and a jumper on the FS pin to vary for high- or low-speed motor applications. Power can be provided externally, up to 16 V, through the power header. The PWM, RD, FG, and GND signals are all brought out to surface mounted test points.

The DRV11873EVM is configured so that connections to only the motor and power supply are required.

2.1 Power Connectors

The DRV11873EVM uses a combination of headers for the application and monitoring of power. For the EVM, only a single power-supply rail is necessary. Minimum recommended Vin for the EVM is 5 V and maximum is 16 V. Please see the datasheet for the DRV11873 for complete voltage range information of the driver itself. When power is supplied to the board a green LED (D3) in the upper-left corner should enable.

The overcurrent threshold setup pin sets the current limit for the device and is connected to a 3.3-kΩ resistor (R3) on the DRV11873EVM. This sets the current limit at 2 A for the DRV11873. This resistor can be replaced and a new current limit set using Equation 1. Please see the datasheet for the DRV11873 for more information on the overcurrent threshold setup pin.

$$I_{LIMIT}\ (mA) = 6600 / R_{CS}\ (\Omega) \text{ for } 500\ mA < I_{LIMIT} < 2000\ mA \quad (1)$$

VCC for the DRV11873 is directly taken off the H1 power supply header. The H1 header is located on the top side of the EVM near the top of the board as shown in Figure 1.

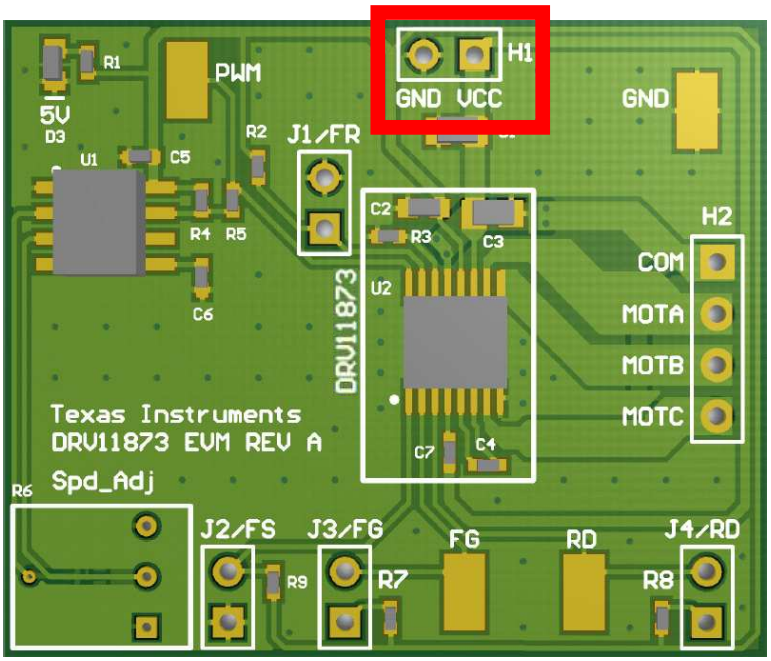

Figure 1. Top View (H1 Power Supply Header)

2.2 Test Points

Test points are provided and labeled according to the inputs and outputs of the DRV11873 motor driver. The signals brought out to test points are labeled *FG*, *RD*, *PWM*, and *GND*.

The signal *PWM* is generated by circuitry on the EVM. In order to provide your own PWM signal to the motor driver, remove the 0.0-Ω resistor (R5) and connect your own PWM signal to the *PWM* test point. The *PWM* signal generated by the circuitry on the EVM is approximately 25 kHz and can be adjusted from 5% to 95% duty cycle by the potentiometer (R6) located on the EVM.

The FG signal's frequency represents the motor speed and phase information.

$$RPM = (FG \times 60) / \text{pole pairs} \quad (2)$$

Please refer to the datasheet of the DRV11873 for more information regarding the FG pin.

The RD pin is an open drain output which is tied to 5 V through a pull-up resistor. In this case, the pull-up resistor value (R8) is 100 kΩ. During the lock protection condition, RD output remains high until the lock protection is dismissed and restart completed. A current limit function has been built in for the RD pin which prevents the open drain MOSFET from damage in case VCC or 5 V directly connects to the RD pin. Please refer to the datasheet of the DRV11873 for more information regarding the RD pin.

2.3 Jumpers

There are four jumpers (J1 – J4) on the EVM that are normally installed.

Jumper J1 connects the FR pin of the DRV11873. When installed, the pin is set low for forward rotation. When removed, the pin is pulled high and the motor will spin in reverse.

Jumper J2 connects the FS pin of the DRV11873 to adjust for different speed selections for various applications. When installed, the FS pin is set to pull low. When J2 is open, the FS pin pulls high.

Jumper J3 connects the FG pin of the DRV11873 to an onboard pull-up resistor to 5 V. Remove jumper J3 if the use of an external pull-up resistor is desired.

Jumper J4 is used to connect the RD pin of the DRV11873 through a pull-up resistor to 5 V. When removed, the pin will float.

For normal operation right out of the box, all jumpers should be installed.

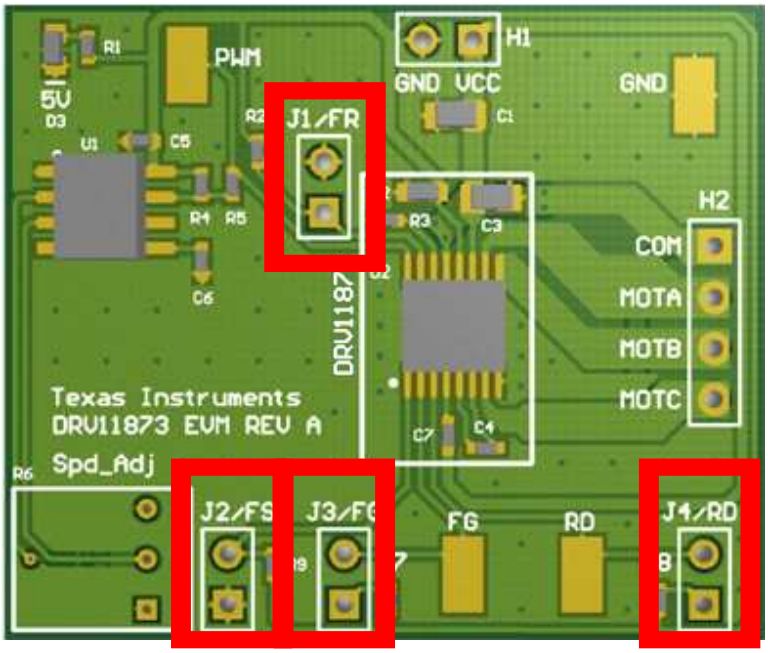

Figure 2. Jumper Settings

2.3.1 FR Forward and Reverse (J1) Jumper

J1 can be found in Figure 2. Installing the jumper connects the FR pin on the DRV11873 to GND. When the FR pin is tied to GND, the motor is set to spin in forward rotation. When removed, the pin is pulled high and the motor will spin in reverse. **FR is latched upon power to the EVM so power must be cycled in order for the motor direction to change.**

2.3.2 FS Frequency Select (J2) Jumper

J2 can be found in Figure 2. Installing the jumper connects the FS pin on the DRV11873 to GND. When the FS pin is tied to GND, the DRV11873 is set for optimized startup for low fan speed motors with high motor winding resistance and high inductance. With the jumper out, the FS pin pulls up to VCC through a pull-up resistor. When the FS pin is tied to VCC, the DRV11873 is optimized for startup for high speed fan motors with low motor winding resistance and high inductance. **FS is latched upon power to the EVM so power must be cycled in order for the FS output to change.**

2.3.3 FS Frequency Generator (J3) Jumper

J3 can be found in Figure 2. Installing the jumper will connect the FG pin of the DRV11873 to an on board pull-up resistor. If you wish to make an external connection to FG, the jumper can be removed and the FG test point provides a direct connection to the FG pin of the DRV11873. The FG test point is highlighted in Figure 3. Please note that if the jumper is removed, an external pull-up resistor is needed for connection of FG to an external system. For more information regarding the FG pin please refer to the DRV11873 datasheet (SLWS237).

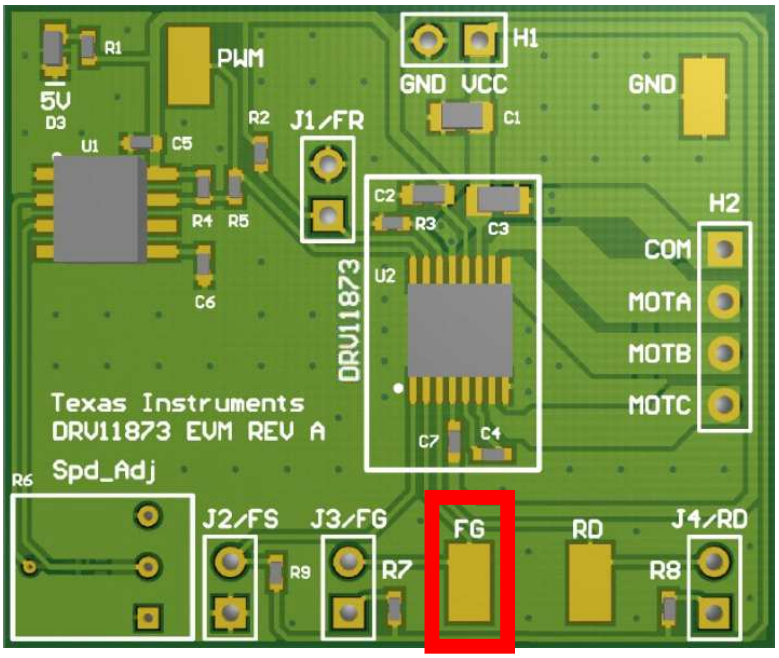

Figure 3. FG Test Point

2.3.4 RD Rotation Detection (J4) Jumper

The RD pin is an open-drain output which is tied to 5 V through a pull-up resistor when J4 is in place. In this case, the pull-up resistor value (R8) is 100 kΩ. During the lock protection condition, RD output remains high until the lock protection is dismissed and restart completed. With J4 removed, the pin will float when the lock protection condition occurs. The jumper allows for external pull-up resistors to be used to change the value of RD when lock detection takes place. Please refer to the datasheet of the DRV11873 for more information regarding the RD pin.

2.4 Speed Adjust Potentiometer (R6)

The speed-adjust potentiometer *Spd_Adj* can be found in Figure 4. The potentiometer adjusts the duty cycle of the PWM signal which, will in turn, adjust the speed of the motor. In order to lower the duty cycle, and in turn, lower the speed, turn the potentiometer clockwise. In order to increase the duty cycle, and in turn, increase the speed, turn the potentiometer counter-clockwise.

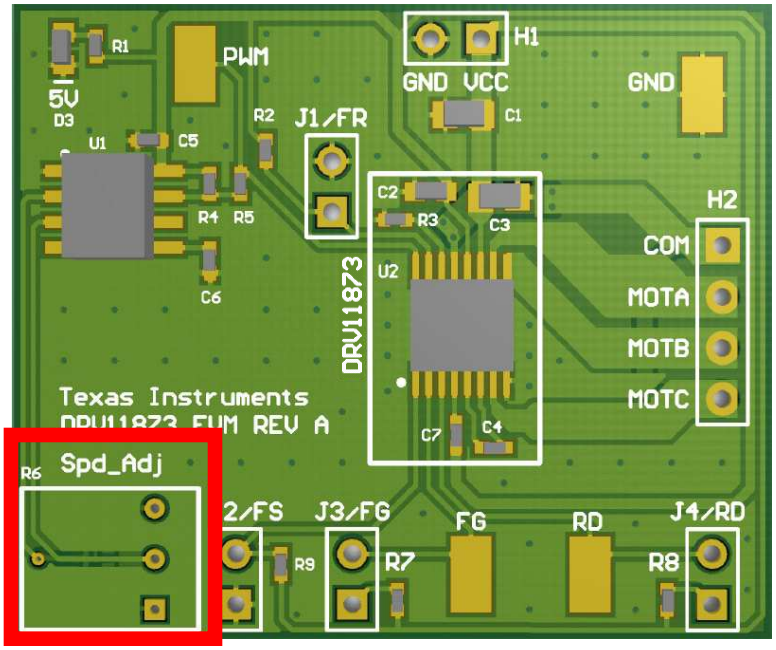

Figure 4. DRV11873 Speed-Adjust Potentiometer

The onboard PWM signal for the DRV11873 is generated by a circuit based upon TI's TLC555 Low Power Timer. It is capable of an approximately 25-kHz output that can be adjusted from 5% to 95% duty cycle. This square output signal will switch from 0 V to 5 V.

In order to provide an external PWM signal to the DRV11873, first remove the 0.0-Ω resistor, R5. Next, connect the external PWM signal to the *PWM* surface mounted test point. For more information on the PWM input required by the DRV11873 please refer to the datasheet.

2.5 Motor Outputs

Connect a three-phase 12-V BLDC motor to pins A, B, C, and COM of the header H2. Polarity is not critical for A, B, and C. The motor outputs are located on H2 as shown in Figure 5.

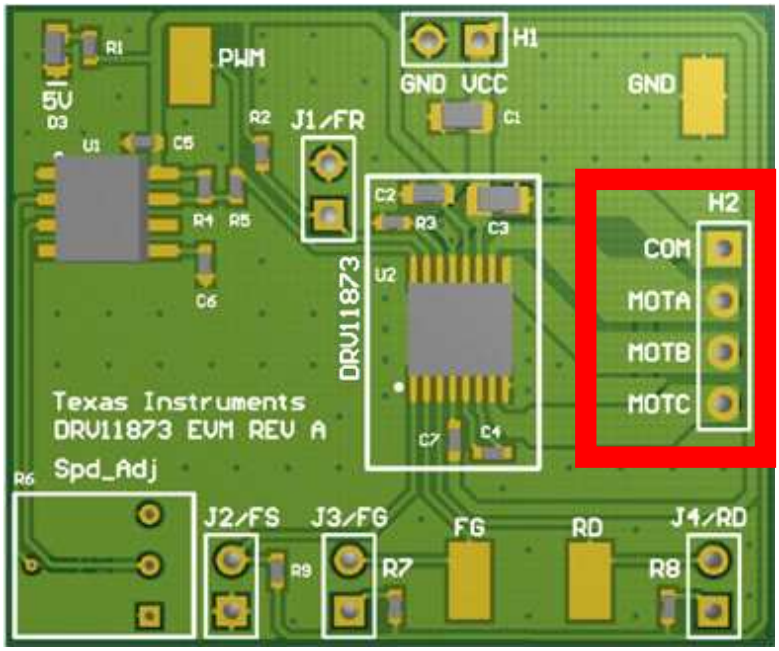

Figure 5. DRV11873 Motor Outputs

2.6 Operation of the EVM

1. Connect a 12-V, three-phase BLDC motor to pins A, B, C, and COM of **H2**.
2. Adjust the *Spd_Adj* potentiometer (**R6**) to minimum voltage by turning it all the way clockwise. This will minimize the motor speed.
3. Apply power to the H1 header.
4. Adjust the *Spd_Adj* potentiometer counter-clockwise towards the motor outputs to increase speed and the motor will start to turn. Continue adjusting as desired.
5. To change direction, disconnect power and remove J4.

3 Schematic

Figure 6 is the DRV11873 schematic.

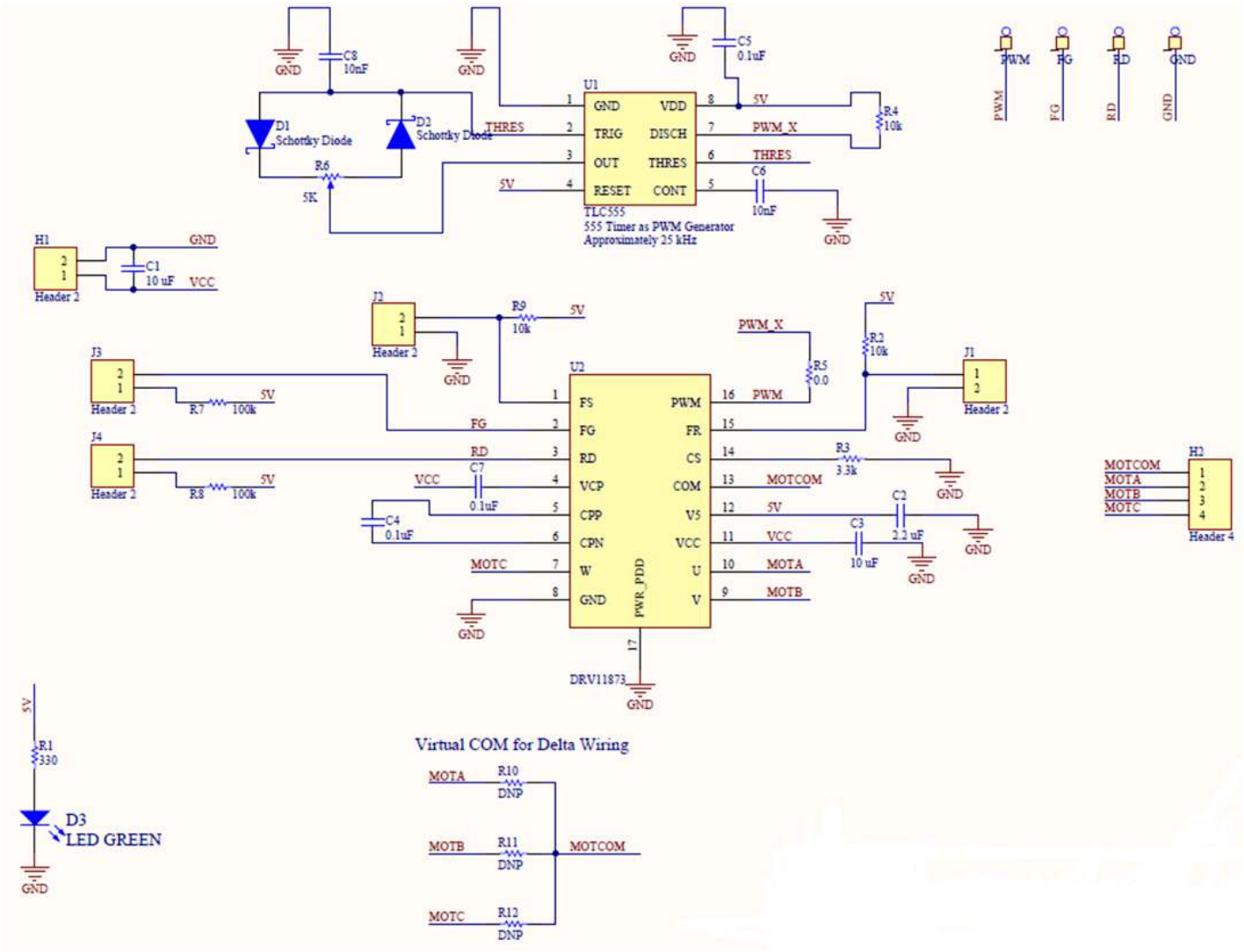

Figure 6. DRV11873 Schematic

4 Bill of Materials

Table 1 is the bill of materials for the EVM.

Table 1. DRV11873 Bill of Materials

Description	Designator	DigiKey Part #	Manufacturer	MFG Part Number	Qty
CAP CER 10UF 25V 10% X5R 0805	C1, C3	490-5523-1-ND	Murata Electronics North America	GRM21BR61E106KA73L	2
CAP CER 2.2UF 25V 10% X5R 0603	C2	587-2909-1-ND	Taiyo Yuden	TMK107ABJ225KA-T	1
CAP CER 0.1UF 25V Y5V 0402	C4, C5, C7	445-3445-1-ND	TDK Corporation	C1005Y5V1E104Z	3
CAP CER 10000PF 25V 10% X7R 0402	C6, C8	445-1260-1-ND	TDK Corporation	C1005X7R1E103K	2
DIODE SCHOTTKY 1A 40V MICROSMP	D1, D2	MSS1P4-M3/89AGICT-ND	Vishay General Semiconductor	MSS1P4-M3/89A	2
LED 1.6X0.8MM 570NM GRN CLR SMD	D3	754-1116-1-ND	Stanley Electric & Co	HBR1105W-TR	1
PC TEST POINT MINIATURE SMT	FG, GND, PWM, RD	534-5019 (Mouser)	Keystone Electronics	5019	4
Header, 2-Pin	H1, J1, J2, J3, J4	3M9447-ND	3M	961102-6404-AR	5
Header, 4-Pin	H2	3M9449-ND	3M	961104-6404-AR	1
RES 330 OHM 1/10W 5% 0402 SMD	R1	P330JCT-ND	Panasonic - ECG	ERJ-2GEJ331X	1
RES 10K OHM 1/10W 5% 0402 SMD	R2, R4, R9	P10KJCT-ND	Panasonic - ECG	ERJ-2GEJ103X	3
RES 3.3K OHM 1/10W 5% 0402 SMD	R3	P3.3KJCT-ND	Panasonic Electronic Components	ERJ-2GEJ332X	1
RES 0.0 OHM 1/16W 0402 SMD	R5	311-0.0JRCT-ND	Yageo	RC0402JR-070RL	1
POT 5.0K OHM THUMBWHEEL CERM ST	R6	3352T-502LF-ND	Bourns Inc.	3352T-1-502LF	1
RES 100K OHM 1/10W 5% 0402 SMD	R7, R8	P100KJCT-ND	Panasonic - ECG	ERJ-2GEJ104X	2
RES 1DNP 5% 0603 SMD	R10, R11, R12	DNP	DNP	DNP	3
IC OSC MONO TIMING 2.1MHZ 8-SOIC	U1	296-10341-1-ND	Texas Instruments	TLC555QDR	1
12-V, 3-PHASE, SENSORLESS BLDC MOTOR DRIVER	U2	Supplied	Texas Instruments	DRV11873	1

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