DRV8834 Evaluation Module

This document is provided as a supplement to the DRV8834 datasheet (SLVSB19). It details the hardware implementation of the DRV8834 customer evaluation module (EVM).

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1 Introduction

The DRV8834 customer EVM is a platform revolving around the DRV8834, a low voltage dual H-bridge driver and highly configurable power stage. This device has been optimized to drive either two brushed DC motors, a single bipolar stepper with up to 32 degrees of internally generated microstepping, or a single bipolar stepper with high resolution externally generated microstepping. In this EVM, high resolution is meant to imply 512 degrees of microstepping, but higher resolution, as given by any given DAC resource, can be implemented.

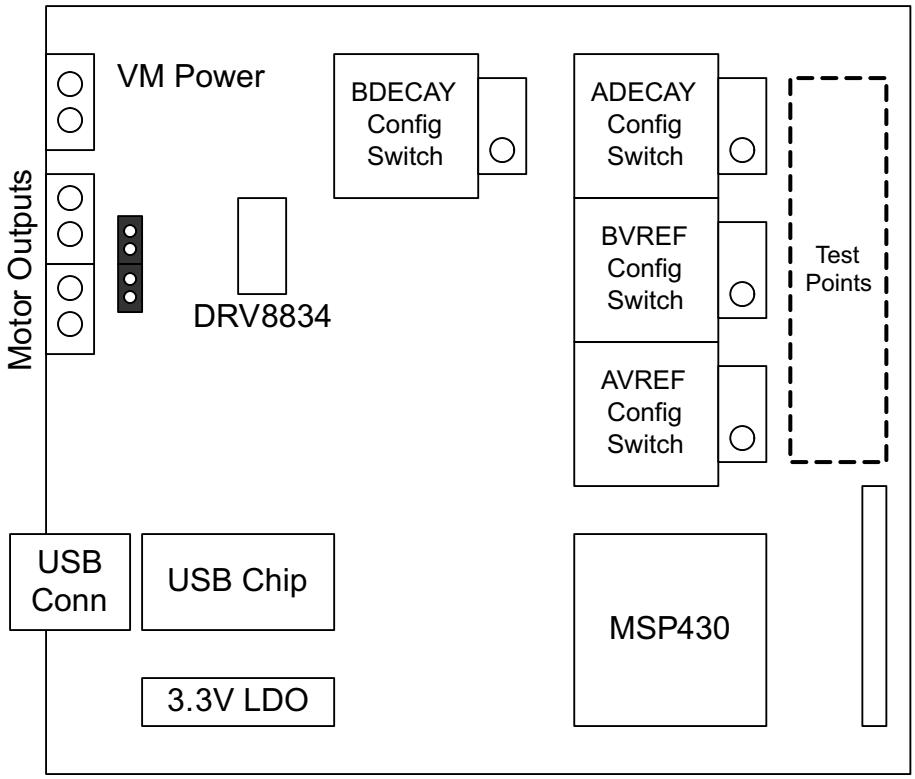
The EVM houses an MSP430 microcontroller and an USB interface chip. The USB chip allows for serial communications from a PC computer where a Windows® application is used to schedule serial commands. These commands can be used to control each of the device's signals, or control both devices at the same time to drive a stepper motor.

The microcontroller firmware operates in one of three modes. Each of the three modes can be selected through the Windows application by choosing the respective operation TAB. The three modes are:

- Dual H-Bridge with independent current control and PWM control on the ENABLE and PHASE lines.
- Internal indexer microstepping driver capable of supplying up to 32 degrees of microstepping to a single bipolar stepper motor.
- Dual H-Bridge configured to supply up to 512 degrees of microstepping to a single bipolar stepper motor.

This user's guide details the operation of the EVM in any of the three modes, as well as the hardware configurability of the evaluation module.

2 Block Diagram



2.1 Power Connectors

The DRV8834EVM offers access to VM (motor voltage) power rail via a terminal block (J1). A set of test clips in parallel with the terminal block allows for the monitoring of the input power rail.

User must apply VM according to datasheet recommended parameters.

NOTE: VDD for logic and microcontroller is derived from a provided 3.3-V regulator stepped down from the VM input voltage.

2.2 Test Stakes

A 0.100 inch pitch header connector (J3) is used to provide access to every device signal in the event a different microcontroller is to be employed. To disconnect the internal MSP430 microcontroller, simply remove power to this resource by removing the shunt from the JP3 jumper.

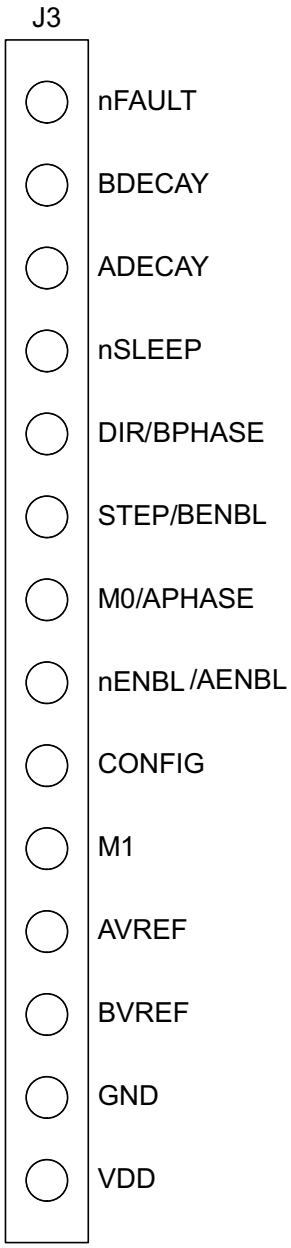


Figure 1. J3 Connector

2.3 Jumpers

The DRV8834EVM module contains three 2-pin jumpers which the user can remove in order modify certain aspects of configuration.

- JP1: Place a shunt to enable the D1 LED signaling of any fault occurrence.
- JP3: Place a shunt to allow 3.3-V supply to the microcontroller. Remove the shunt to disable MSP430 microcontroller and use external microcontroller of choice.
- JP4: Place a shunt to provide VM power to the LDO. Remove to disconnect all VM loading except DRV8834 device.

2.4 Switches

A series of switches allow the proper selection of analog input to configure the reference voltage and decay set points.

Table 1. Switches

SWITCH NAME	DESCRIPTION
BDECAY SEL	Selects Decay B source to be MSP430 GPIO (only HI or LO), externally supplied or derived from the R1 potentiometer.
ADECAY SEL	Selects Decay A source to be MSP430 GPIO (only HI or LO), externally supplied or derived from the R2 potentiometer.
BVREF SEL	Selects Reference Voltage B source to be same as VREFA (used on internal indexer mode), MSP430 DAC, externally supplied or derived from the R7 potentiometer.
AVREF SEL	Selects Reference Voltage A source to be MSP430 DAC, externally supplied or derived from the R6 potentiometer.

Each switch position is properly documented on the board's top layer overlay silk screen.

2.5 Motor Outputs

There are two ways of connecting the dual brushed DC motor or the single bipolar stepper motor into the DRV8834 evaluation module: four pin header (J2) or four position terminal block (J4).

3 Installing Drivers and Software

3.1 Installing the FTDI USB Driver

The USB driver can be easily installed on any Windows system (Windows XP 32 or 64 bits, Windows Vista, Windows 7) by double clicking the included "CDM20814_Setup.exe". The USB peripheral will be installed as a Virtual COM Port (VCP). The Windows applications will enumerate all available COM ports during startup. While connecting, the application will attempt to communicate with the module. Once communications have been successfully established, the EVM will be ready for evaluation purposes.

3.2 Installing the DRV8834 Evaluation Board Windows Application Software

The Windows application can be installed by running the Setup.exe file found in the DRV8834EVM folder.

3.3 Running the Windows Application Software

The application can be started by clicking Start → Programs → Texas Instruments, Inc. → DRV8834_CustomerEVM link.

4 The Windows Application

The DRV8834EVM Windows application is the software counterpart for the DRV8834 EVM. It allows the PC computer to connect to the MSP430F2617 microcontroller though an USB interface chip. Once connection is established and commands are sent, microcontroller takes care of configuring control signals and administering certain levels of automation, such as microstepping coordination, stepping rate acceleration and deceleration, ITrip configuration and PWM generation.

The graphical user interface (GUI) has been designed to allow for all of the DRV8834 device's functionality to be tested without having to intervene with the hardware, except for the adjusting of the reference voltage and decay selector switches.

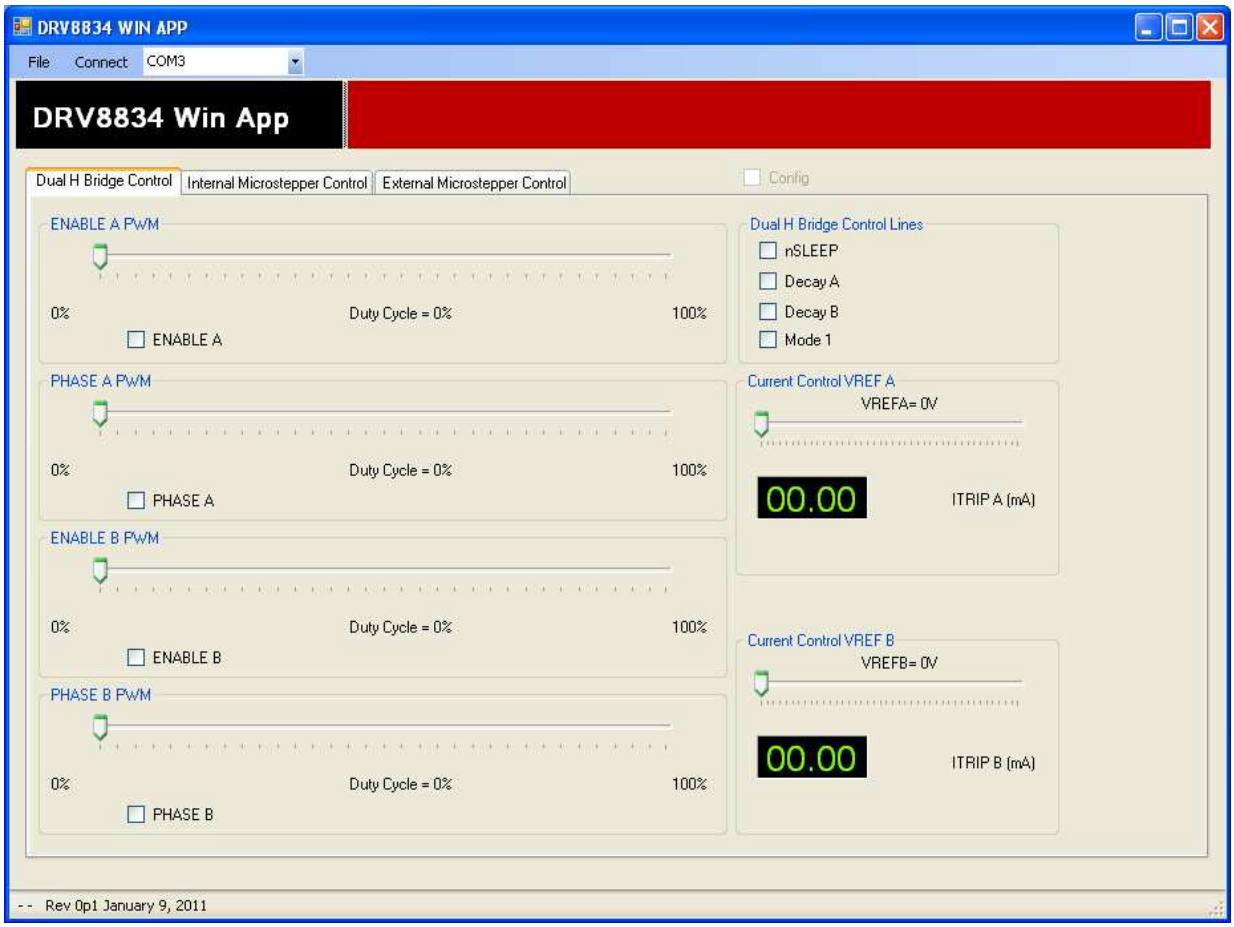


Figure 2. DRV8834EVM.exe Main Screen

All the control signals needed to control motor enablement (nENABLE or ENABLEx), direction of rotation (PHASEx or DIR), current control (VREFx) and PWM control for both enablement and direction control signals are made available throughout one of the three control tabs.

Each one of the three tabs will place the microcontroller and driver chip into one of the three operation modes. The three tabs are described below.

4.0.1 Dual H Bridge Mode

See Figure 2.

While in this mode, the microcontroller treats the DRV8834 as a dual H-bridge driver with independent current regulation, motor enablement and phase control.

In this mode, the Windows application offers control to ENABLE each of the two motors and control the rotation direction. It also allows control of the speed and/or direction by offering access to a PWM resource to each of the ENABLEx and PHASEx signals. Both H-bridges can be programmed with a current regulation parameter by moving the VREFx slider. Other control signals are offered in the form of check boxes.

4.0.2 Internal Microstepper Control

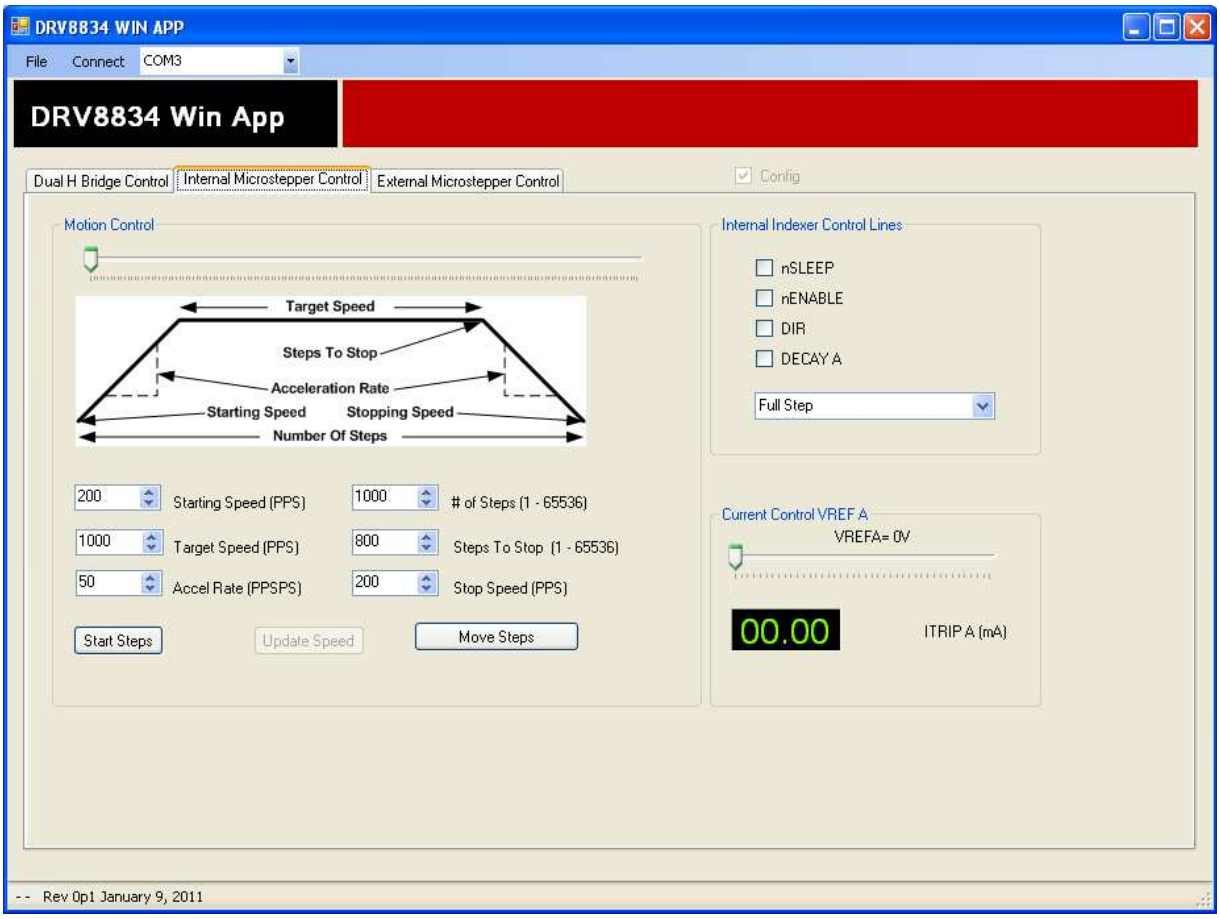


Figure 3. Internal Microstepper Control

While in this mode, the microcontroller treats the DRV8834 as an internal indexer microstepper with up to 32 degrees of microstepping driver.

In this mode, the Windows application offers control to ENABLE the driver, change motor rotation, select current regulation decay, select degrees of microstepping resolution and modify maximum current programming.

The Windows application also offers access to a series of sophisticated algorithms which allow the stepper motor actuation in both continuous rotation as well as position control mode. The algorithms offer accurate acceleration and deceleration profiles which help in the obtaining of better motion quality and performance.

4.0.3 External Microstepper Control

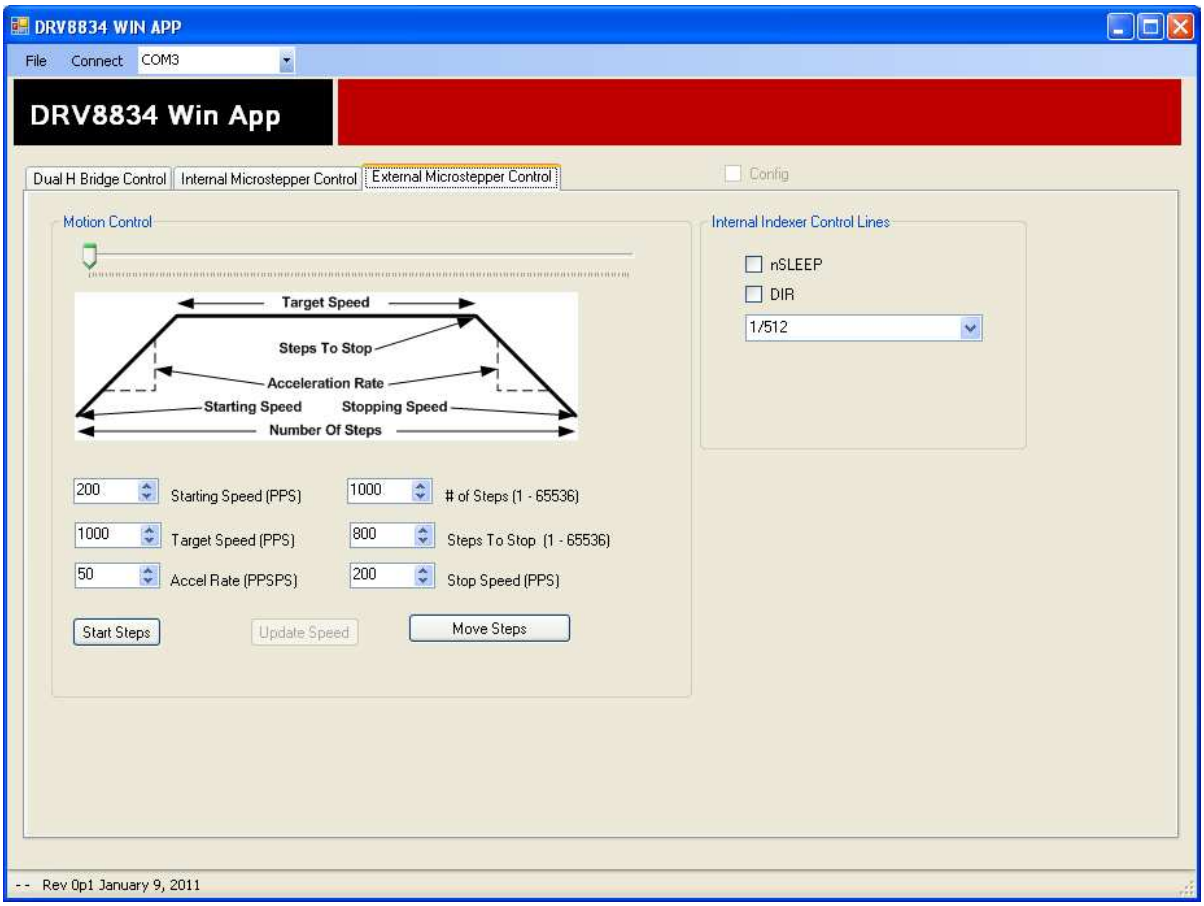


Figure 4. External Microstepper Control

While in this mode, the microcontroller treats the DRV8834 as a dual H-bridge driver with independent current regulation, motor enablement and phase control. Different than the dual H-bridge control mode in which two DC motors can be driving, while in this operation style, the microcontroller will recognize commands to issue high resolution microstepping commutation into a bipolar stepper motor.

In this mode, the Windows application offers control to change motor rotation and select degrees of microstepping resolution. The decay is programmed into the microcontroller high resolution microstepping algorithm to follow sine wave shape generation (slow decay while on quadrants 1 and 3, and mixed decay while on quadrants 2 and 4). Current is set to 1.5-A sine wave peak. To change the maximum current, the firmware's internal look up table must be modified.

The Windows application also offers access to the same series of sophisticated algorithms which allow the stepper motor actuation in both continuous rotation as well as position control mode. The algorithms offer accurate acceleration and deceleration profiles which help in the obtaining of better motion quality and performance.

4.1 The CONFIG Control Signal

In this Windows application, the CONFIG control signal is not made available to the user. The application will modify the control signal according to which TAB is selected. When the communications are made and any tab gains focus, a serial command is sent to the microcontroller to set the CONFIG control signal accordingly. If the COM Port is not open, the serial command pertaining to this configuration is not sent.

4.2 Configuring Switches

Although the proper setting of the CONFIG control signal is made automatically, the EVM switches must still be properly configured if correct operation is to be observed. Failure to properly set these switches will result in problems with the current regulation and stepper motor functioning.

The following table shows the recommended switch positions as a different tab is selected. "Required" implies that the wrong operation will be observed if not followed. Optional implies that any other source (like the pot or an external signal) can be used, although control through the Windows application will be lost.

Table 2. Recommended Switch Positions

	DUAL H-BRIDGE	INTERNAL INDEXER	EXTERNAL INDEXER
BDECAY	MSP430 (optional)	MSP430 (optional)	MSP430 (required)
ADECAY	MSP430 (optional)	MSP430 (optional)	MSP430 (required)
BVREF	MSP430 (optional)	AVREF (required)	MSP430 (required)
AVREF	MSP430 (optional)	MSP430 (optional)	MSP430 (required)

4.3 The Menu

The menu at the top of the application offers a series of quick options for how the COM port is to behave.

1. **File → Exit:** Terminates the application.
2. **Connect:** Opens the serial port. When this menu item is pressed, its caption changes to “Disconnect”.
3. **Disconnect:** Closes the serial port. When this menu item is pressed, its caption changes to “Connect”.
4. **COMx:** A series of available COM ports will be shown. To determine which COM port is the VCP, the user can go into the Windows’ Device Manager and determine which one of the enumerated COM ports is using the FTDI driver.

After opening the application, the order of events should be:

1. Select the COM Port from the COMx drop down box.
2. Press Connect. If COM ports are available, the application will search for the EVM. If no EVM is found, an error message will notify the user. If the port is available and communications are successfully made, the menu item changes its “Connect“ caption to “Disconnect“. Press "Disconnect" to disable the serial communications.
3. After pressing any command button, <1><0><0> should return on the bottom status bar as an acknowledgement of proper communications taking place with the board.
4. The application is now ready for use.
5. Closing down the application (via the Close X or File → Exit) will close the serial port connection, so it is not necessary to press "Disconnect" before closing down the application.

4.4 DRV8834 GPIO Control Signals

Once the application is communicating with the interface board, the control signals can be actuated by checking or un-checking boxes on any of the respective control signals frames.

Functionality of control signals is as follows. A checked box translates to a HI level on the respective control signal. Un-checked boxes translate to a LO level on the respective control signals.

4.5 Updating DAC Output for Current Control (VREF)

During evaluation, the user may want to study the operation of the ITRIP regulation scheme. Both MSP430F2617 MCU DAC channels can be controlled through the provided sliders. Moving these sliders will result on the regulated current to be directly proportional to the slider position per Equation 1.

$$I_{TRIP} = \frac{xVREF}{5 \bullet R_{SENSE}}, \; with \; R_{SENSE} = \; 0.2 \; \Omega \tag{1}$$

It must be noted, however, that during stepper actuation with the external indexer method, the DAC channels are controlled by the microcontroller's microstepping application.

Figure 5. Current Control (VREF)

The 12-bit DAC channels 0/1 are connected to the DRV8834 VREF analog inputs VREF. Changing the DAC digital value from 0 to 4095, changes the analog voltage at the respective VREF pin from 0 V to 2.5 V respectively. See Equation 2.

$$VREF = DAC\_VALUE \bullet \frac{2.5\ V}{4095} \tag{2}$$

Where VREF is the MCU DAC output voltage into the DRV8834 device and DAC_VALUE is a number from 0 to 4095 as, in this case, specified by the slider position.

4.6 Stepper Control

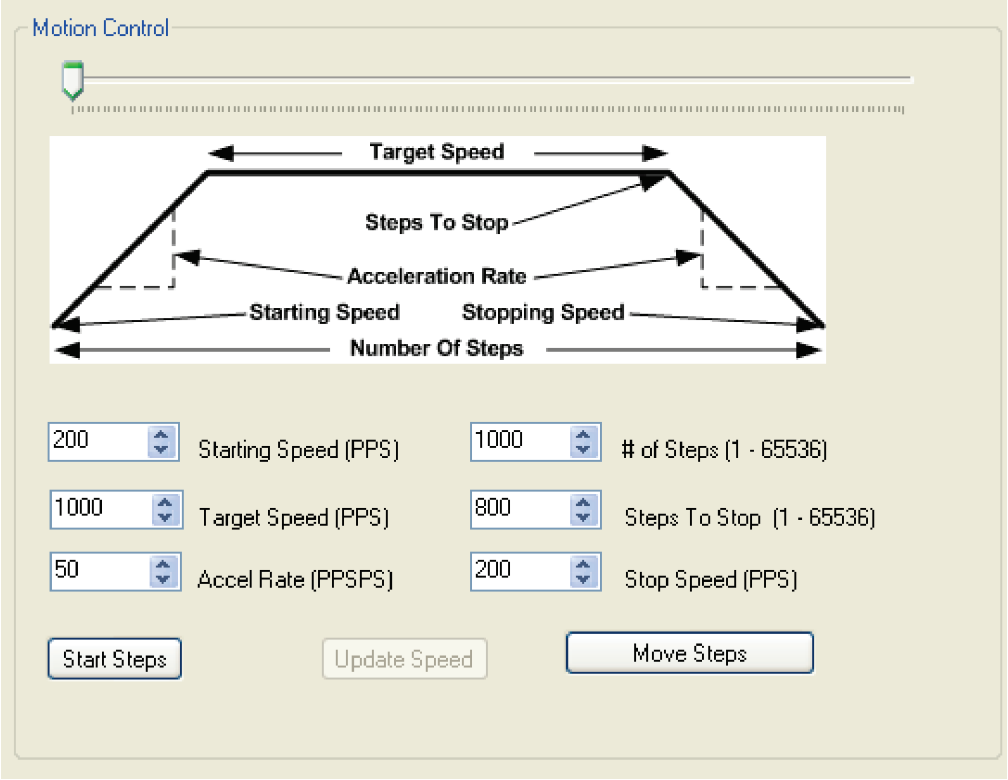


Figure 6. Motion Control

The Windows application has an area which offers access to a series of very useful stepper control algorithms. The user can control motor enablement, rotation rate, direction of rotation, current decay mode during microstepping, microstepping resolution (from full step to 32 degrees of microstepping in internal indexer mode or half step to 512 degrees of microstepping on external indexer mode) and number of steps the motor will move.

Motor motion can only happen by using an acceleration profile which will be detailed later on. A detailed explanation of each stepper control section follows.

4.6.1 Motion Control Frame

This frame allows the configuration and running of the stepper with the direction as specified by the DIR checkbox, with the current decay mode as specified under the Decay checkbox and the microstepping resolution as specified under the Microstepping Resolution drop down box.

The Motion Control frame gathers user information regarding stepping rate, or motor speed. An acceleration profile is employed to start at a programmable speed and increase stepping rate until reaching the programmable desired speed.

An internal 8-MHz timer is used to measure time and generate the steps on a timely manner. The Windows application will transform the entered number of PPS and transform it into the respective clock cycles needed for the timer to generate accurate STEP pulse timing.

The acceleration profile is coded inside of the microcontroller to accept both the starting speed PPS and target speed PPS as a clock cycle number. When the start steps command is issued (Starts Steps button is pressed), an interrupt service routine (ISR) generates steps at a rate specified by the start speed PPS parameter.

The very same start steps command computes how frequent automatic speed updates are issued and a second timer is used to change the speed according to the programmed acceleration rate profile.

Once the target speed PPS is reached, the acceleration profile ends and the motor stays running until the stop stepper command is issued (Stop Steps button). When the stepper is commanded to stop, the controller does exactly as it did while accelerating, but in reverse as to achieve deceleration until the stop speed PPS is reached, in which case the motor fully stops.

A second motor actuation is provided by the move steps command in which a programmed number of steps are issued and then the motor stopped. The acceleration and deceleration profiles work similarly as before, except when the deceleration starts to happen and when the motor actually stops are a function of the steps to stop and deceleration rate parameters.

Figure 7 shows the acceleration profile and the role each parameter plays during speed computation.

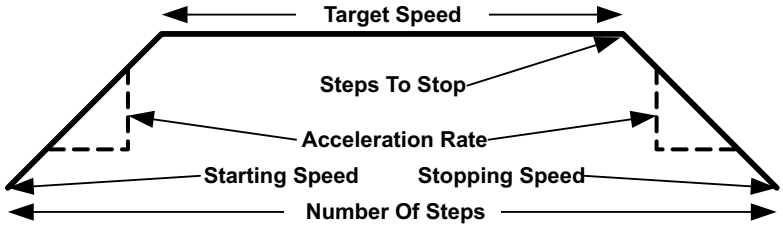


Figure 7. Acceleration Profile

The following controls are available within the motor control frame:

Start Speed PPS: Number of pulses per second (or full steps per second) at which the motor will rotate at the beginning of operation. The SW will only allow a number as small as 200 PPS and can be taken to a number as large as 65535 PPS.

Target Speed PPS: Number of pulses per second (or full steps per second) at which we want the motor to operate. The acceleration profile will start from the start speed PPS and increase stepping rate until reaching the desired speed PPS. The SW will only allow a number as small as 200 PPS and can be taken to a number as large as 65535 PPS.

Acceleration Rate (0-5000): A number from 0 to 5000 which acts as a stepping rate modifier to increase the start speed PPS up to target speed PPS.

Stop Speed PPS: Number of pulses per second (or full steps per second) at which the motor will stop rotating after the stop stepper command is invoked and the deceleration profile is issued. The deceleration profile modifies the stepper speed from the target speed and into the stop speed.

4.7 Move Steps Frame

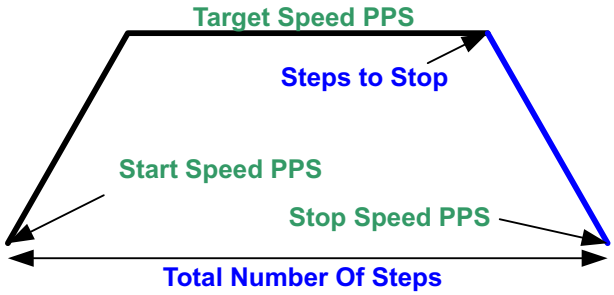
If the user desires to move the stepper a certain number of steps, this can be easily accomplished by using the move steps function. Parameters from the other frames are reused and its utilization is as explained previously. Two new parameters have been added to properly control the limited number of steps actuation.

Number of Steps: Amount of steps the controller will issue.

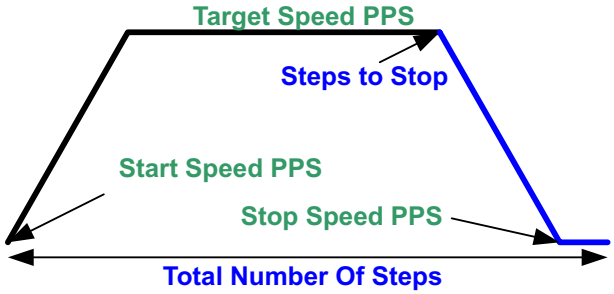
Steps to Stop: The controller is continuously monitoring the step being issued and when the current step is equal to the steps to stop parameter, a deceleration profile is issued. If steps to stop is larger than the number of steps, then the motor stops abruptly and without undergoing a deceleration profile.

When a deceleration profile is issued, the controller decreases the speed until reaching the stop speed value. If the number of steps parameter is met before the deceleration profile is complete, then the motor stops at the current speed. If the stop speed is met before all the number of steps are issued, then the motor rotates at the stop speed value until all the steps are executed.

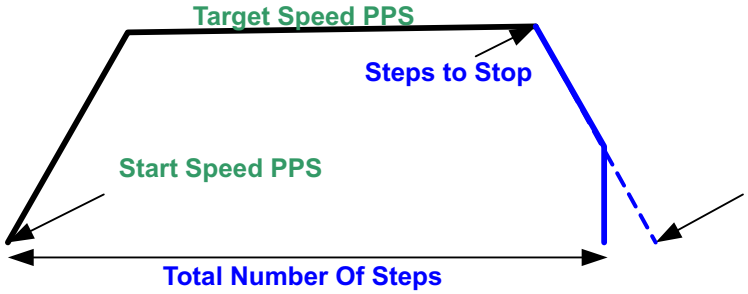
Ideally, the system must be tuned to resemble as much the case in which the controller executes all the commanded steps at a speed as close as possible to the stop speed. In the event this is not possible, due to the particular parameters being chosen, stopping the motor at a speed very close to the stop speed is often good enough to ensure good motion quality and application performance.



Motor Reaches Stop Speed at the Stop Speed



Motor Reaches Stop Speed before the Stop Speed is reached



Motor runs out of Steps before reaching Stop Speed

Figure 8. Move Steps

4.7.1 Microstepping Resolution

Segmenting a full step into microsteps can be achieved by how many times we can divide the current regulation magnitude. The DRV8834 device offers the flexibility of using either internal indexing with up to 32 degrees of microstepping for the simplest implementation, or infinite degrees of microstepping when using the an external reference voltage source.

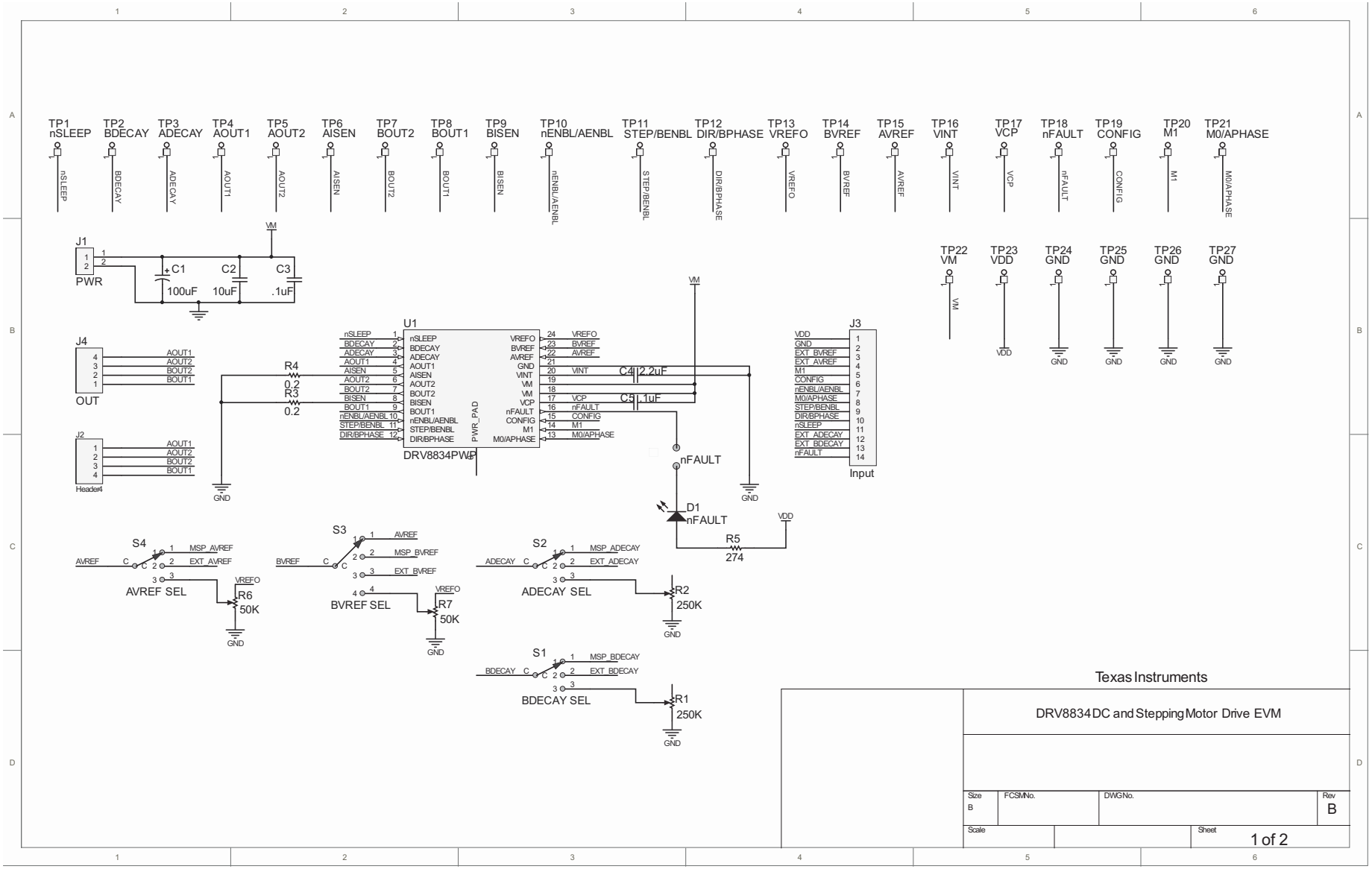
The Microstepping Resolution drop down box gives the user the option to change the full step divider factor so that microsteps from half step to 512 degrees of microstepping are obtained, depending on the chosen operating mode.

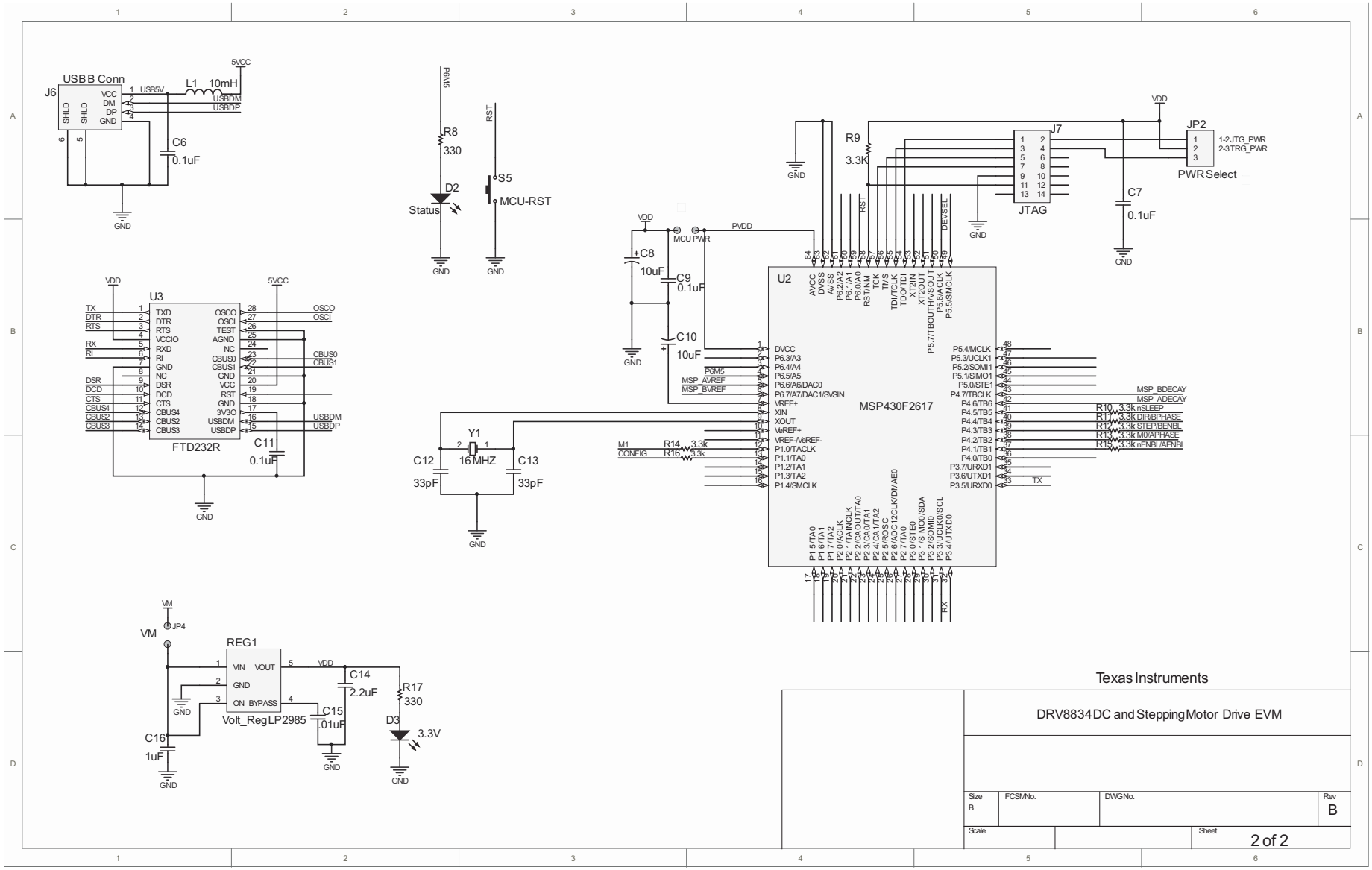
5 Schematics and Bill of Materials

5.1 Schematics

The following pages contain the schematics for the DRV8834EVM.

The DRV8834EVM schematics are also available in the form of a PDF file (SCH.pdf) inside the EVM_Related folder on the downloadable EVM software package.





5.2 Bill of Materials

DESIGNATOR	DESCRIPTION	MANUFACTURER	MFG PART NUMBER	VALUE	QUANTITY
C1	Polarized Capacitor (Radial)	Nichicon	RNE1C101MDS1PX	100uF	1
C2	Capacitor	TDK Corporation	C2012X5R1C106M	10uF	1
C3, C5	Capacitor	TDK Corporation	C1608X7R1E104K	.1uF	2
C4	CAP CER 2.2UF 10V Y5V 0603	TDK Corporation	C1608Y5V1A225Z	2.2uF	1
C6, C7, C9, C11	CAP .10UF 50V CERAMIC X7R 0805	Kemet	C0805C104K5RACTU	0.1uF	4
C8, C10	10uF, 25V Electrolytic Cap (Radial)	Nichicon	UVR1E100MDD	10uF	2
C12, C13	CAP CERAMIC 33PF 50V NP0 0805	Yageo	CC0805JRNP09BN330	33pF	2
C14	Capacitor	TDK Corporation	C1608X5R0J225K	2.2uF	1
C15	Capacitor	Murata Electronics North America	GRM188R71E103KA01D	.01uF	1
C16	Capacitor	TDK Corporation	C1608Y5V1C105Z	1uF	1
D1, D2, D3	LED RED CLEAR 1206 SMD	Stanley Electric & Co	HBR1105W-TR	LED RED	3
J1	TERM BLOCK 5.08MM VERT 2POS PCB	On Shore Technologies	OSTTA024163		1
J2, J5		Sullins Connector Solutions	PBC02SAAN		2
J3	CONN HEADER .100 SINGL STR 14POS	Sullins Connector Solutions	PBC14SABN		1
J4	TERM BLOCK 5.08MM VERT 4POS PCB	On Shore Technology Inc	OSTTA044163		1
J6	CONN USB RT ANG RECPT TYPE B BLK	Molex	67068-8000	USB B	1
J7	CONN HEADER .100 DUAL STR 14POS	Sullins	PBC07DAAN	14 Pos Header	1
JP1, JP3	Two Pin Jumper	Sullins Connector Solutions	PBC02SAAN	0.230" (5.84mm)	2
JP2	CONN HEADER .100 SINGL STR 3POS	Sullins	PBC03SAAN	3 Pos Header	1
JP4	Two Pin Jumper	Phoenix Contact	1945096	NA	1
L1	Ferrite Bead 1.5A 40 ohm 0805 SMD	Laird-Signal Integrity Products	MI0805K400R-10	10mH	1
R1, R2	TRIMMER 10K OHM 0.25W TH	Murata Electronics North America	PV37Y254C01B00	250K	2
R3, R4	RES .2OHM 2W 1% 2512 SMD	Stackpole	CSRN2512FKR200	0.2	2
R5	Resistor	Panasonic - ECG	ERJ-6ENF2740V	274	1
R6, R7	TRIMMER 10K OHM 0.25W TH	Murata Electronics North America	PV37Y503C01B00	50K	2
R8, R17	RES 330 OHM 1/8W 5% 0805 SMD	Yageo	RC0805JR-07330RL	330	2
R9	RES 3.3K OHM 1/8W 5% 0805 SMD	Yageo	RC0805JR-073K3L	3.3K	1
R10, R11, R12, R13, R14, R15, R16	Resistor	Panasonic - ECG	ERJ-3GEYJ332V	3.3k	7
REG1	VoltageRegulator	Texas Instruments	LP2985-50DBVR		1
S1, S2, S4		Copal Electronics	SS-10-23NP-LE		3
S3		Copal Electronics	S-2150		1
S5	SWITCH LIGHT TOUCH 4.3MM 100GF	Panasonic	EVQ-11A04M	Push Button	1

TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21	Glass Beaded Test Point	Kobiconn	151-101-RC	WHITE	21
TP22	Glass Beaded Test Point	Kobiconn	151-107-RC	WHITE	1
TP23	Glass Beaded Test Point	Kobiconn	151-107-RC	RED	1
TP24, TP25, TP26, TP27	Glass Beaded Test Point	Kobiconn	151-103-RC	BLACK	4
U1	Stepping and DC motor Driver	Texas Instruments			1
U2	IC MCU 16BIT 55K FLASH 64-LQFP	Texas Instruments	MSP430F2617TPMR	MSP430 MCU	1
U3	USB Chip	FTDI	FT232RL R	USB Driver	1
Y1	CRYSTAL 8.00 MHZ 20PF 49US	ECS Inc.	ECS-160-20-4X	Crystal	1

Revision History

Changes from Original (March 2012) to A Revision	Page
• Changed Schematics	14

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM’s electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI’s recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

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OCEAN CHIPS
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Поставка электронных компонентов

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- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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AVIC JONHON

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FORSTAR®

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