FEB154-001 User's Guide
Motor Control Evaluation Board Using the Motion-SPM™ (FSBB20CH60) in a Mini-DIP (44mm x 26.8mm) Package

Contents

1. Introduction

This user's guide supports the FSBB20CH60 Motion-SPM™ in a mini-DIP package evaluation board. It should be used in conjunction with the FSBB20CH60 data sheet and Fairchild's SPM application note AN-9035.

1.1 Product Description

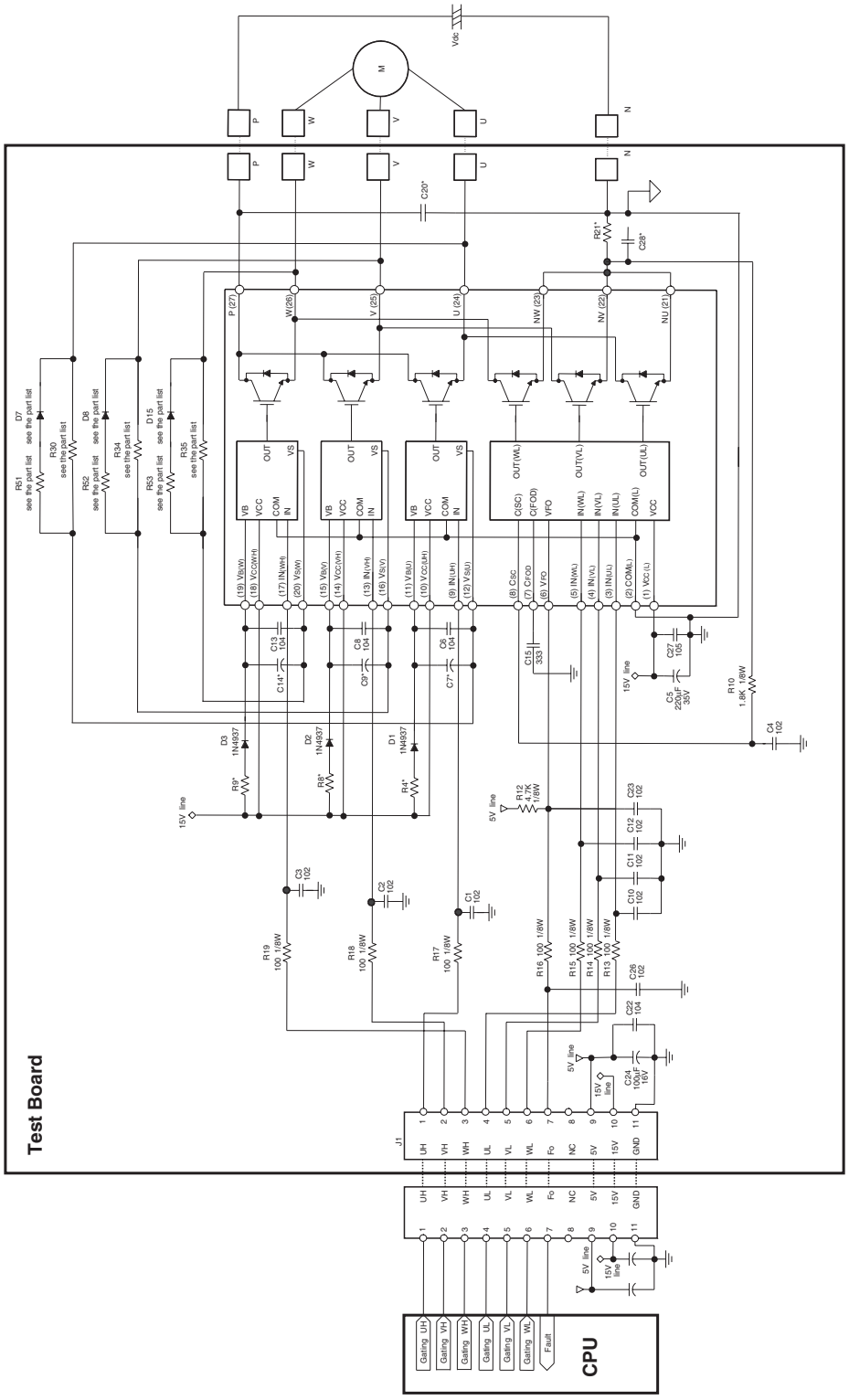
Fairchild's Smart power Module (SPM™) products provide efficient motor control for energy-restricted low-power inverter-driven applications, such as washing machines and air conditioners. The FSBB20CH60 Motion-SPM™ integrates three high-voltage ICs (HVICs), one low-voltage IC (LVIC), six IGBTs for three-phase inverter and six fast recovery diodes. Fairchild's Motion-SPM reduces board space by utilizing an ultra-compact 44mm x 26.8mm Mini-DIP package and by incorporating built-in HVICs that provide an optocoupler-less, single supply IGBT gate driving capability. The FSBB20CH60 product offers designers high reliability with integrated under-voltage lock out (UVLO) and short circuit (SC) protection.

1.2 Circuit Description

The Motion-SPM is installed as the switching module in this evaluation board and has direct interface with the CPU using one shunt resistor. The DC-link(P and N) input terminals are connected into the corresponding terminals in Motion-SPM and three-phase (U,V,W) output terminals from SPM are wired into motor input. Since the three HVICs are integrated in the Motion-SPM, 3 parts of bootstrap circuit are needed, which consists of bootstrap capacitor, charge resistor for charging boost capacitor, blocking diode for high voltage isolation. One shunt resistor is used for sensing short current and the related short current circuit is composed of an external shunt resistor and R-C low pass filter. The signal of fault output pin VFO drops from high level to low when a fault, such as UV (Under Voltage) or SC (Short Circuit), happens. A pull-up resistor and filter capacitor are needed to support this action. Six R-C low pass filters are used between input connector from a DSP controller (or other controllers) and gate input signal pins of Motion-SPM.

2. Designed Solution

2.1 Schematic



Notes:

*See the part list.

1. Common-grounded power supplies of +5V and +15V are used for CPU and SPM operation.
2. The ceramic capacitor placed between Vcc-com(C27) should be over 1uF and mounted as close to the pins of the SPM as possible.
3. For further details, see the datasheet and application note.

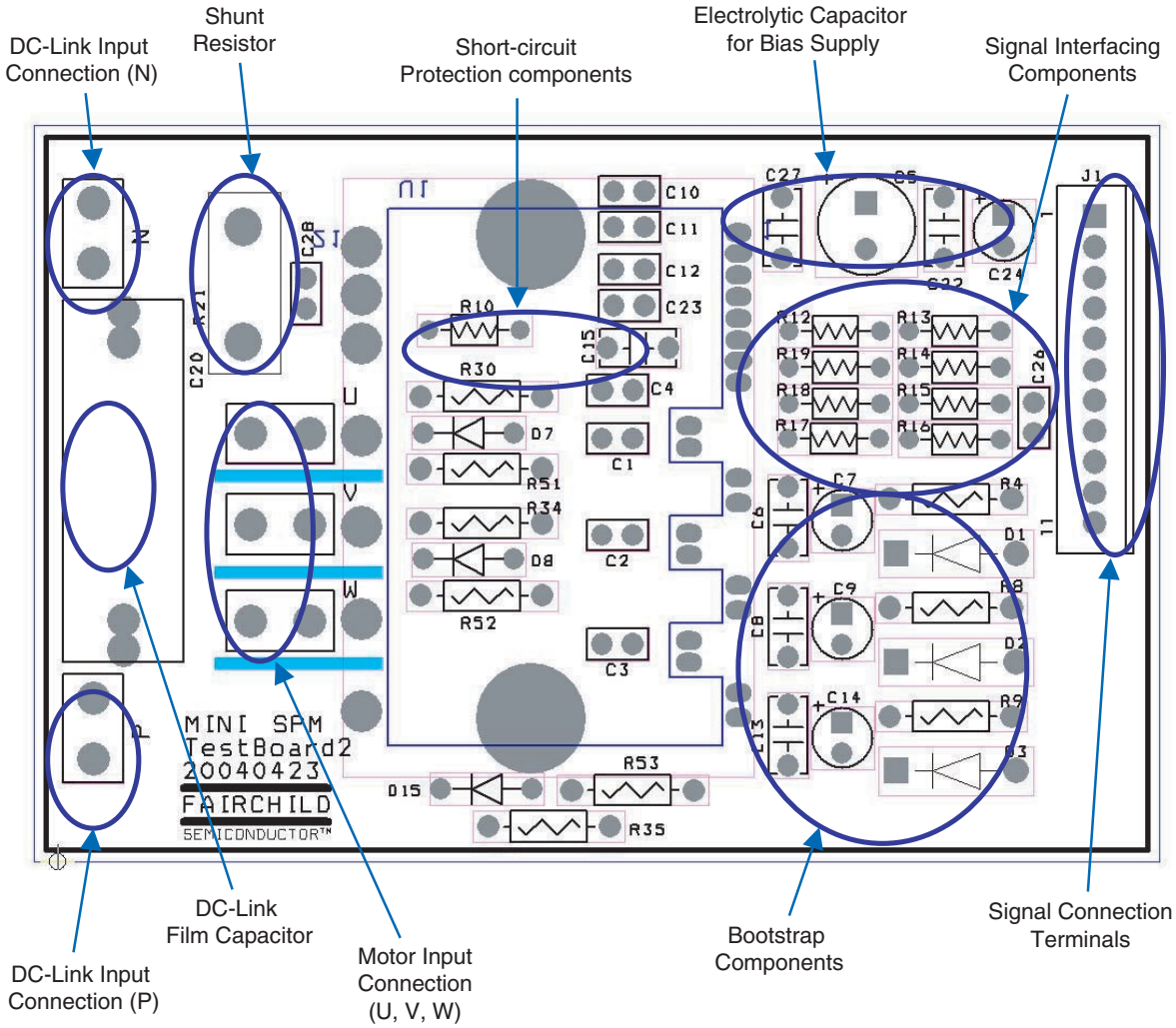
2.2 Bill of Materials

Part No.	Rating	Characteristics	Definition
R4	20W, 1/4W	Carbon Film Resistor (5%)	Bootstrap Resistor (Phase U)
R8	20W, 1/4W	Carbon Film Resistor (5%)	Bootstrap Resistor (Phase V)
R9	20W, 1/4W	Carbon Film Resistor (5%)	Bootstrap Resistor (Phase W)
R10	1.8kW, 1/8W	Carbon Film Resistor (5%)	Low-Pass-Filter for Current Sensing
R12	4.7kW, 1/8W	Carbon Film Resistor (5%)	Pull-Up Resistor (Fault-Out)
R13	100W, 1/8W	Carbon Film Resistor (5%)	Series Resistor for Signal Interface (UL)
R14	100W, 1/8W	Carbon Film Resistor (5%)	Series Resistor for Signal Interface (VL)
R15	100W, 1/8W	Carbon Film Resistor (5%)	Series Resistor for Signal Interface (WL)
R16	100W, 1/8W	Carbon Film Resistor (5%)	Series Resistor for Signal Interface (Fault-Out)
R17	100W, 1/8W	Carbon Film Resistor (5%)	Series Resistor for Signal Interface (UH)
R18	100W, 1/8W	Carbon Film Resistor (5%)	Series Resistor for Signal Interface (VH)
R19	100W, 1/8W	Carbon Film Resistor (5%)	Series Resistor for Signal Interface (WH)
R21	15mW , 5W	Non-inductive Resistor (1%)	Shunt Resistor for Current Sensing (OC Level: about 33A)
R30	5.6W, 1/4W	Carbon Film Resistor (5%)	Emitter Resistor for Switching
R34	5.6W, 1/4W	Carbon Film Resistor (5%)	Emitter Resistor for Switching
R35	5.6W, 1/4W	Carbon Film Resistor (5%)	Emitter Resistor for Switching
R51	Omit	Carbon Film Resistor (5%)	Emitter Resistor for Switching – Refer to AN9035
R52	Omit	Carbon Film Resistor (5%)	Emitter Resistor for Switching – Refer to AN9035
R53	Omit	Carbon Film Resistor (5%)	Emitter Resistor for Switching – Refer to AN9035
C1	1nF	Ceramic Capacitor	High-Side Pull-down Capacitor (Phase U)
C2	1nF	Ceramic Capacitor	High-Side Pull-down Capacitor (Phase V)
C3	1nF	Ceramic Capacitor	High-Side Pull-down Capacitor (Phase W)
C4	1nF	Ceramic Capacitor	Bypass Capacitor for Current Sensing
C5	220μF, 35V	Electrolytic Capacitor	+15V Bias Voltage Source Capacitor
C6	100nF	Ceramic Capacitor	Bypass Capacitor for Bootstrap Supply (Phase U)
C7	6.8uF, 35V	Electrolytic Capacitor	Bootstrap Capacitor (Phase U)
C8	100nF	Ceramic Capacitor	Bypass Capacitor for Bootstrap Supply (Phase V)
C9	6.8uF, 35V	Electrolytic Capacitor	Bootstrap Capacitor (Phase V)
C10	1nF	Ceramic Capacitor	Low-Side Pull-down Capacitor (Phase U)
C11	1nF	Ceramic Capacitor	Low-Side Pull- down Capacitor (Phase V)
C12	1nF	Ceramic Capacitor	Low-Side Pull- down Capacitor (Phase W)
C13	100nF	Ceramic Capacitor	Bypass Capacitor for Bootstrap Supply (Phase W)
C14	6.8μF, 35V	Electrolytic Capacitor	Bootstrap Capacitor (Phase W)

Part No.	Rating	Characteristics	Definition
C15	33nF	Ceramic Capacitor	Capacitor for Selection of Fault Out Duration
C20	100nF, 630V	Film Capacitor	Snubber Capacitor to Suppress the Spike-Voltage
C22	100nF	Ceramic Capacitor	+5V Bias Voltage Bypass Capacitor
C23	1nF	Ceramic Capacitor	By-pass Capacitor of Fault-Out Signal
C24	100μF, 16V	Electrolytic Capacitor	+5V Bias Voltage Source Capacitor
C26	1nF	Ceramic Capacitor	Bypass Capacitor for Fault-Out Signal
C27	1μF	Ceramic Capacitor	+15V Bias Voltage Bypass Capacitor
C28	1nF	Ceramic Capacitor	Bypass Capacitor for Shunt Resistor
D1	1A, 600V	Fast Recovery Diode, (1N4937)	Bootstrap Diode (Phase U)
D2	1A, 600V	Fast Recovery Diode, (1N4937)	Bootstrap Diode (Phase V)
D3	1A, 600V	Fast Recovery Diode, (1N4937)	Bootstrap Diode (Phase W)
D7	Omit	Switching Diode (Gate turn-off path)	Emitter Diode for Switching – Refer to AN9035
D8	Omit	Switching Diode (Gate turn-off path)	Emitter Diode for Switching – Refer to AN9035
D15	Omit	Switching Diode (Gate turn-off path)	Emitter Diode for Switching – Refer to AN9035
U1	FSBB20CH60	Motion-SPM in Mini-DIP	

2.3 Printed Circuit Board

2.3.1 PCB Map



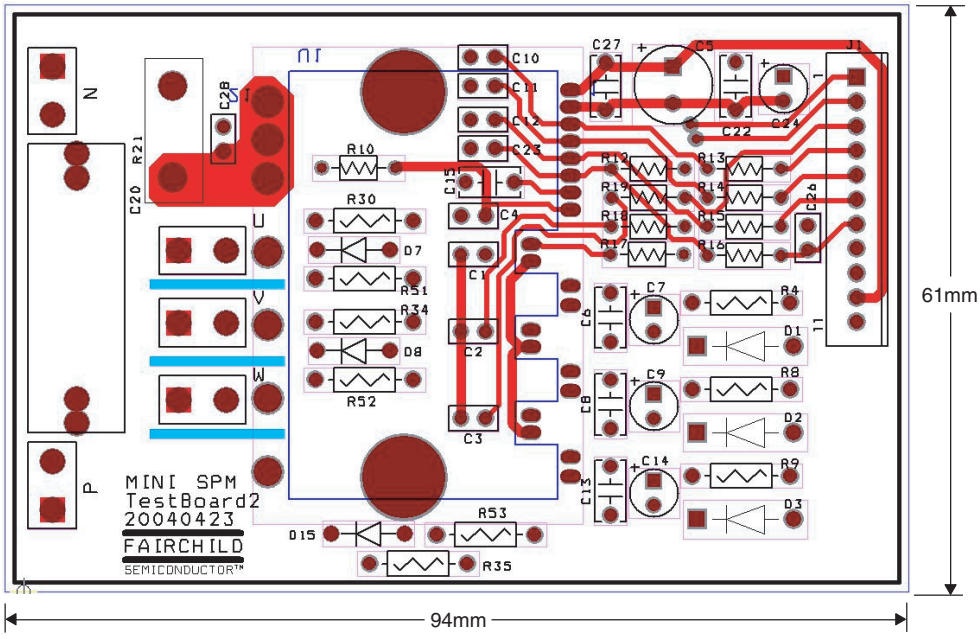
2.3.2 Circuit Layout Design

1. To avoid malfunction, the wiring of each input should be as short as possible. (less than 2–3cm)
2. To prevent protection function errors, the 'R10' and 'Csc' wiring should be as short as possible.
3. All the by-pass capacitors and filter capacitors should be placed very close to SPM.
4. The short-circuit protection time constant R10 • CSC should be set in the range of 1~2μsec.
5. The isolation distance of DC-P, U-phase, V-phase, W-phase, DC-N/GND blocks should be over 2.54mm(100mil) for 300V~500V P-N voltage.
6. Power-GND and signal-GND should be connected with each other through only one 1.5~2mm width pattern.
7. To prevent surge destruction, the wiring between the filter capacitor and the P & Ground pins should be as short as possible. The use of a high frequency non-inductive capacitor of around 0.1~0.22μF between the P & Ground pins is recommended. In addition to reducing local voltage spikes, the placement and quality of this capacitor will have a direct impact on both conducted and radiated EMI.

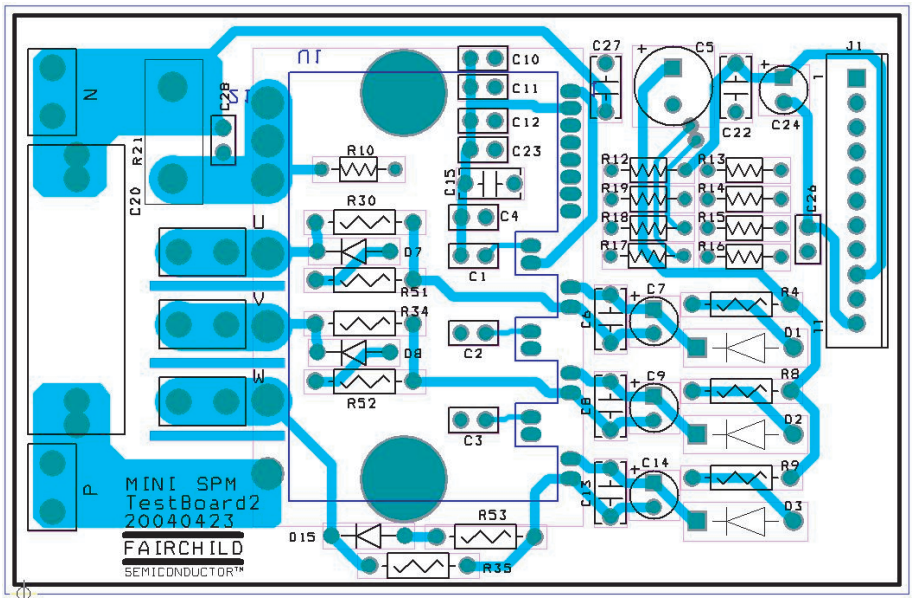
2.3.3 External Connection

Signal Interface (J1)	1	High-Side Input Signal from CPU (Phase U)
	2	High-Side Input Signal from CPU (Phase V)
	3	High-Side Input Signal from CPU (Phase W)
	4	Low-Side Input Signal from CPU (Phase U)
	5	Low-Side Input Signal from CPU (Phase V)
	6	Low-Side Input Signal from CPU (Phase W)
	7	Fault-Out Signal to CPU
	8	NC
	9	SPM Bias Supply +5V Terminal
	10	SPM Bias Supply +15V Terminal
	11	SPM Bias Supply Ground Terminal
Power Connection	P	Positive DC Link Input Connection
	N	Negative DC Link Input Connection
	U	Motor Input Connection (Phase U)
	V	Motor Input Connection (Phase V)
	W	Motor Input Connection (Phase W)

2.3.4 Wiring of PCB



(a) Top Side View



(b) Bottom Side View

WARNING AND DISCLAIMER

Replace components on the Evaluation Board only with those parts shown on the parts list in the User's Guide. Contact an authorized Fairchild representative with any questions.

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