X-NUCLEO-IHM07M1

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Power Electronics

- Use a switching mechanism (i.e. on-off transistor) to partialize the current.
- Use a desired logic to switch on and off the transistor.
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(Voltage) Control

• Logic: Pulse Width Modulation
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Voltage Control

\[ i(t) = \frac{V}{R} \left(1 - e^{-\frac{t}{L/R}}\right) \]

![Diagram showing voltage control and current vs time]
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• Voltage Control

- The switching of the output voltage on the output of a drive by the IGBT bridge generates rapid variations in voltage (dV/dt).

Motor current nearly sinusoidal

Drive output voltage (PWM) dV/dt 2 to 10kV/μS

V_{DC \text{ bus}}

e.g. 400 \times \sqrt{2} = 566V

0 V

- V_{DC \text{ bus}}
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H-Bridge
X-NUCLEO-IHM07M1
## X-NUCLEO-IHM07M1

### Table 1: Jumper settings

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Permitted configurations</th>
<th>Default condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP1</td>
<td>Selection for pull-up insertion (BIAS) in current sensing circuit</td>
<td>OPEN</td>
</tr>
<tr>
<td>JP2</td>
<td>Selection for op amp gain modification in current sensing circuit</td>
<td>OPEN</td>
</tr>
<tr>
<td>JP3</td>
<td>Selection for pull-up enabling in Hall/Encoder detection circuit</td>
<td>CLOSED</td>
</tr>
<tr>
<td>J9</td>
<td>Selection to supply the STM32 Nucleo board through the X-NUCLEO-IHM07M(1)</td>
<td>OPEN</td>
</tr>
<tr>
<td>J5</td>
<td>Selection for single/three shunt configuration. Set to single shunt by default</td>
<td>2-3 CLOSED</td>
</tr>
<tr>
<td>J6</td>
<td>Selection for single/three shunt configuration. Set to single shunt by default</td>
<td>2-3 CLOSED</td>
</tr>
<tr>
<td>J7</td>
<td>Debug connector for DAC. Available for probe connection</td>
<td>OPEN</td>
</tr>
</tbody>
</table>
Figure 4: X-NUCLEO-IHM07M1 – top layer with silk-screen

CN7
ST Morpho connector
CN6
Arduino UNO Connector
CN8
Arduino UNO Connector
U11
L6230 driver
U10
TSV994IPT op. amp.
J1
Power supply connector
J9
Enable VIN supply voltage
JP1, JP2
Jumpers for FOC
SPEED
Potentiometer
Figure 4: X-NUCLEO-IHM07M1 – top layer with silk-screen

- CN10
- ST Morpho connector
- CN5
- Arduino UNO Connector
- CN9
- Arduino UNO Connector
- J2
- Motor connector
- J3
- Hall/Encoder sensor connector
- J7
- Debug connector
- JP3
- External pull-up for sensors
- J5, J6
- Current measure mode (1Sh/3Sh)
- D11
- LED status indicator
# X-NUCLEO-IHM07M1

## Table 3: ST morpho connector table

<table>
<thead>
<tr>
<th>Pin</th>
<th>Default</th>
<th>Signal</th>
<th>Solder bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PC10</td>
<td>Enable_CH1-L6230</td>
<td>R58</td>
</tr>
<tr>
<td>2</td>
<td>PC11</td>
<td>Enable_CH2-L6230</td>
<td>R67</td>
</tr>
<tr>
<td>3</td>
<td>PC12</td>
<td>Enable_CH3-L6230</td>
<td>R72</td>
</tr>
<tr>
<td>17</td>
<td>PA15</td>
<td>Encoder A/Hall H1</td>
<td>R79</td>
</tr>
<tr>
<td>18</td>
<td>+5V</td>
<td>Encoder/Hall PS voltage</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>PC13</td>
<td>Blue button</td>
<td></td>
</tr>
</tbody>
</table>

(9) For STM32F302-Nucleo only:
## X-NUCLEO-IHM07M1

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>GPIO</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>PA9</td>
<td>VH_PWM</td>
<td>R64</td>
</tr>
<tr>
<td>22</td>
<td>PB2</td>
<td>LED_RED</td>
<td>R83</td>
</tr>
<tr>
<td>23</td>
<td>PA8</td>
<td>UH_PWM</td>
<td>R56</td>
</tr>
<tr>
<td>24</td>
<td>PB1</td>
<td>POTENTIOMETER</td>
<td>R78</td>
</tr>
<tr>
<td>33</td>
<td>PA10</td>
<td>WH_PWM</td>
<td>R70</td>
</tr>
</tbody>
</table>

(9) For STM32F302-Nucleo only:
Analog section – Hall/Encoder motor speed sensor

The X-NUCLEO-IHM07M1 expansion board implements the Hall/Encoder sensor detecting circuit for speed measurement. The motor sensor pin, through the J3 connector and an analog circuit, are connected to the STM32 Nucleo board in order to detect the motor spin; a +5 V and GND are also provided for power supply of the sensors. For sensors that require external pull-up, jumper JP3 is available (see figure below). For this setting please, refer to Table 1: "Jumper settings".
X-NUCLEO-IHM07M1

- Bus Voltage sensing

![Diagram of voltage sensing circuit]
X-NUCLEO-IHM07M1

- Temperature sensing

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RS model 742-8420
Placed near the L6230 driver
L6230
L6230

Diagram showing the pin layout and labels for the L6230.
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<table>
<thead>
<tr>
<th>IN1</th>
<th>Logic input</th>
<th>Logic input half bridge 1.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN1</td>
<td>Logic input</td>
<td>Enable input half bridge 1.</td>
</tr>
<tr>
<td>IN2</td>
<td>Logic input</td>
<td>Logic input half bridge 2.</td>
</tr>
<tr>
<td>EN2</td>
<td>Logic input</td>
<td>Enable input half bridge 2.</td>
</tr>
<tr>
<td>IN3</td>
<td>Logic input</td>
<td>Logic input half bridge 3.</td>
</tr>
<tr>
<td>EN3</td>
<td>Logic input</td>
<td>Enable input half bridge 3.</td>
</tr>
</tbody>
</table>
Figure 15. Six-step with current control typical application
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Current Control

Diagram showing the control of a motor with speed reference, current reference, speed controller, current controller, and speed feedback.
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Current Control

May need the motor position