XHY256-DEMO-V1

Application Demonstration Board Supporting the Freescale Microcontroller

- MC9S12XHY256 MCU

Hardware User Guide

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REVISION

Date	Rev	Comments
May 21, 2010	A	Initial Release
May 28, 2010	B	Updated input voltage for Rev A boards.

CAUTIONARY NOTES

1) Electrostatic Discharge (ESD) prevention measures should be applied whenever handling this product. ESD damage is not a warranty repair item.

2) Axiom Manufacturing reserves the right to make changes without further notice to any product to improve reliability, function or design. Axiom Manufacturing does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under patent rights or the rights of others.

3) EMC Information on the XHY256-DEMO-V1 board:

   a) This product as shipped from the factory with associated power supplies and cables, has been tested and meets with requirements of CE and the FCC as a CLASS A product.

   b) This product is designed and intended for use as a development platform for hardware or software in an educational or professional laboratory.

   c) In a domestic environment this product may cause radio interference in which case the user may be required to take adequate prevention measures.

   d) Attaching additional wiring to this product or modifying the products operation from the factory default as shipped may effect its performance and cause interference with other apparatus in the immediate vicinity. If such interference is detected, suitable mitigating measures should be taken.

TERMINOLOGY

This development board applies option selection jumpers and cut-traces. Terminology for application of the option jumpers is as follows:

Jumper on, in, or installed – jumper is a plastic shunt that fits across 2 pins and the shunt is installed so that the 2 pins are connected with the shunt.

Jumper off, out, or idle – jumper or shunt is installed so that only 1 pin holds the shunt, no 2 pins are connected, or jumper is removed. It is recommended that the jumpers be placed idle by installing on 1 pin so they will not be lost.

Cut-Trace – a circuit trace connection between component pads. The circuit trace may be cut using a knife to break the default connection. To reconnect the circuit, simply install a suitably sized 0-ohm resistor or attach a wire across the pads.

Signal names followed by an asterisk (*) denote active-low signals.

OVERVIEW

The XHY256-DEMO-V1 board (Dashboard) is a mock-up of an automotive instrument cluster designed to showcase the functionality and capabilities of the 16-bit MC9S12XHY256 microcontroller. The Dashboard allows the end-user to develop and debug application code for Motor Control, CAN, LIN, Sound, and LCD applications. The Dashboard applies custom chip-on-glass LCD from S-Tek Displays.

GETTING STARTED

The Dashboard ships with a demonstration program preloaded. The demonstration code illuminates and rotates the motor pointers clock-wise and counter clock-wise. The demonstration code also drives the LCD with a constantly updating display. Lastly, the indicator LEDs blink ON and OFF. Refer to the XHY256-DEMO-V1_QSG for details.

MC9S12XHY256

The MC9S12XHY family is an automotive, 16-bit microcontroller product line that is specifically designed for entry level instrument clusters. This family also services generic automotive applications requiring CAN, LCD, Motor driver control, or LIN/J2602. Typical examples of these applications include instrument clusters for automobiles and 2 or 3 wheelers, HVAC displays, general purpose motor control and body controllers.

Development Support

The MC9S12XHY256 applies an internal S12SDBG module to provide an on-chip trace buffer with flexible triggering capability allowing non-intrusive debug of application software. The S12SDBG module is optimized for S12SCPU debugging.

Typically the S12SDBG module is used in conjunction with the S12SBDM module, whereby the user configures the S12SDBG module for a debugging session over the BDM interface. Once configured the S12SDBG module is armed and the device leaves background debug mode returning control to the user program, which is then monitored by the S12SDBG module.

BDM_PORT Header

A compatible HCS12 BDM cable may be attached to the 6-pin BDM interface header (BDM_PORT). Figure 1: below shows the pin-out for the BDM_PORT header.

Figure 1: BDM_PORT Header – J3

BKGD	**1**	**2**	GND
	3	**4**	RESET*
	5	**6**	VDD

See the MC9S08XHY Reference Manual for details on use and configuration

POWER SUPPLY

Power to the Dashboard is applied through a barrel connector at J4, a 3-position Molex connector at J5, or from the LIN bus input at connector J3. Connector J4 is a 2.1mm, center-positive barrel jack. The 3-position Molex connector accepts Molex Mini-Fit, 4.2mm plugs. Input at either location may range from 7VDC to 20VDC with 12VDC input typical.

Power to the Dashboard may also be applied through the 2x2, Molex, Mini-Fit connector at J3. This input power source is derived from the LIN bus.

An ON/OFF switch at SW5 and an Ignition switch at SW4 are used to control power to the board. SW5 applies main power to the board while SW4 simulates an automotive ignition-switch input. The main power input applies over-current and over-voltage transient protection.

NOTE:

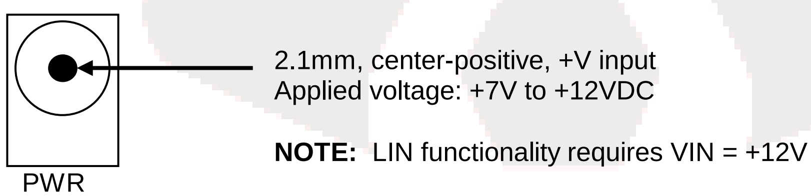
LIN functionality requires input voltage of +12VDC for proper operation.

The Dashboard operates from a 5VDC rail supplied by a switching regulator at VR2. This regulator is capable of supplying up to 1.5A of current output.

Power Input

Power input to the Dashboard consists of a 2.1mm, center-positive, barrel jack and a 3-position, 4.2mm Molex Mini-Fit connector. Input power should remain between +7VDC and +12VDC. Figure 2 below shows the barrel jack connection.

Figure 2: Barrel Connector – J4



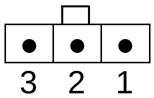
CAUTION:

Input voltage for Rev A boards is limited to +12VDC. Do not exceed this input voltage level; otherwise, damage to the board may occur.

This applies to Rev A boards only

Figure 3 shows the pin-out for the Molex Mini-Fit connector. The connector mates with housing 39-01-4030 and pin 39-00-027.

Figure 3: Alternate Power Input – J5



1: NC
2: GND
3: VIN

Mates with:
Housing, pn 39-01-4030
Pins, pn 39-00-0217

NOTE: Limit input voltage to between +7VDC and +12VDC. Otherwise damage to the board may occur.

Input Protection

Over-current and transient input protection is applied on the Dashboard. Over-current protection is provided by a resettable polyfuse at F1 rated at 1.1A. This device will reset after a delay if the over-current condition is removed. Refer to the part data sheet for further details.

Over-voltage protection is provided by a transient voltage suppressor (TVS) at D8. The TVS activates at approximately 27V to protect the input.

CAUTION: Reverse polarity protection is not applied at the voltage input. Ensure proper polarity is applied when using power input at J5. Otherwise damage to the board my occur

ON_OFF Switch

The ON_OFF toggle switch (SW5) connects and disconnects primary power input to the Dashboard. With the switch in the ON position, the power indicator (+5V) should light. Inspect input power connection, source, and fuse F1 if power indication does not occur.

Ignition Switch

The Ignition Switch (SW4) may be used to simulate ignition in an automotive setting. This input connects to the MC9S12XHY256 ADC input through a voltage divider allowing the user application to detect a “turning the key” input event. The ignition divider is designed to accept voltage inputs up to 27VDC without violating voltage level input.

STEPPER MOTORS

The Dashboard applies 4 stepper motors. Each stepper motor is capable of up to 315^o rotation. In Full-Step mode, each motor rotates in $3/4^o$ step increments. In micro-step mode, each motor rotates in $1/12^o$ step increments.

Each stepper motor has a pointer needle installed to simulate use in an automotive instrument cluster. The Dashboard applies 2 long indicator needles and 2 short indicator needles. Each motor position is marked, in silkscreen, with a scale indicating 1^o, 5^o, and 10^o steps.

Refer to the VID23 manual for details on use and capabilities of these stepper motors. Refer to the Dashboard Schematic for details on electrical connections.

CAUTION:

Do not rotate pointers by hand. Damage to the motor may occur if excessive torque is applied to the motor shaft

Stepper Motor Connections

Each stepper motor is controlled directly by the MC9S12XHY256. The target MCU applies internal H-Bridge drive output capable of driving the stepper motor directly. Electrical connections to each motor are similar. This allows similar waveforms to create similar movement on different motors. The controller should be configured for Full H-Bridge Mode to properly drive the motors. Figure 4 show the connections for each stepper motor.

Figure 4: Stepper Motor Connections

Dashboard Motor	Reference Designator	MC9S2XHY256 H-Bridge Motor Output
MPH	M1	M0C0 / M0C1
FUEL	M3	M1C0 / M1C1
TEMP	M4	M3C0 / M3C1
RPM	M2	M2C0 / M2C1

Refer to the VID23 manual for details on waveform timing requirements.

Pointer Illumination

Each stepper motor pointer may be illuminated under software control. A white LED built-in to the motor provides pointer illumination. Figure 5 shows the pointer illumination control connections for each motor.

Figure 5: Pointer Illumination

Dashboard Motor	Reference Designator	Pointer Illumination Control
MPH	M1	PS4
FUEL	M3	PS6
TEMP	M4	PR3
RPM	M2	PR2

LCD DISPLAY

The Dashboard applies a custom, chip-on-glass, LCD from S-Tek Displays. The GD-5506P provides 4 backplane signals and 40 frontplane signals to activate each of 160 elements. The LCD interfaces directly to the MC9S12XHY256 MCU. The LCD operates at 64 Hz using 1/4 duty and 1/3 bias. The LCD is a transflective, TN type, with a 6 o'clock viewing angle. LED backlighting allows LCD usage in the darkened environments.

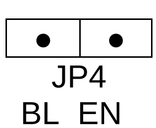
The MC9S12XHY256 applies an integrated LCD controller to drive the LCD panel directly. Refer to the MC9S12XHY256 Reference Manual for details on using and configuring the LCD controller.

LCD BACKLIGHTING

Backlighting allows the use of standard TN LCD's in dark environments. LED backlighting is applied using 8, white LEDs arranged around the perimeter of the LCD panel. A switching boost regulator creates the voltage necessary to drive the LEDs at constant current.

An enable option header allows the user to disable this feature if is not needed.

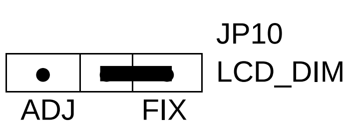
Figure 6: Backlight Enable Option Header – JP4



ON Enabled
OFF Disabled

A LCD_DIM option header allows the user to dim the LCD backlight under MCU control. By default this option is set to fixed brightness when shipped from the factory.

Figure 7: Backlight Enable Option Header – JP10



ADJ: Allows PWM dimming under control of MCU
FIX: Provides fixed brightness output (default)

CAN

Though not exclusively intended for automotive applications, the CAN protocol is designed to meet the specific requirements of a vehicle serial data bus: real-time processing, reliable operation in the EMI environment of a vehicle, cost-effectiveness, and required bandwidth. The Dashboard applies a CAN transceiver to support CAN signaling.

The MC9S12XHY256 applies the Freescale scalable controller area network protocol controller module. This module is a communication controller implementing the CAN 2.0A/B protocol as defined in the Bosch specification dated September 1991. Refer to the MC9S12XHY256 Reference Manual for details on use and configuration of the XHY256 CAN module.

CAN Port

The Dashboard applies the TJA1040T CAN transceiver to interface between the CAN protocol controller and the physical bus. This device is primarily intended for high speed applications, up to 1 Mbaud operation. The device provides differential transmit capability to the bus and differential receive capability to the CAN controller. A 4-pin MOLEX connector provides an interface to external CAN cabling. Figure 8 below shows the CAN connector pin-out.

Figure 8: CAN Port

Pin	TJA1040 CAN Transceiver Signal
1	CANL
2	CANH
3	GND
4	NC

NOTE: CAN Port Connector – Molex, 39-30-3045

Mates with; Housing – Molex ,39-01-4040, Pin – Molex, 39-00-0036

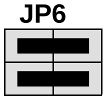
The differential CAN signals are terminated by 120 ohms. This termination may be removed using the option jumpers at JP6. Avalanche diodes protect the CAN PHY from voltage transients on the differential signal lines.

CAN Port Termination

CAN bus termination may be removed using option header JP6.

Figure 9: CAN_EN Option Header – JP6

JP6



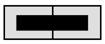
CTERM

		ON	OFF	
JP6	CANL	Enabled	Disabled	Enable / Disable CANL Termination
	CANH	Enabled	Disabled	Enable / Disable CANH Termination

CAN_EN Option Header

The CAN_EN option header enables or disables the CAN PHY. Enable CAN signaling by setting this option jumper to ON. Remove the CAN_EN option jumper to force the CAN transceiver into low-power, stand-by mode. Figure 10 below shows the CAN_EN pin-out.

Figure 10: CAN_EN Option Header – JP8

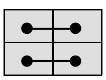


JP8		ON	OFF
	CAN_EN	Enabled	Disabled

CAN TX & RX Enable

MCU logic signals connect to the CAN transceiver through an option header at JP5. This option header is not installed in default configurations; however, cut-traces on the bottom of the board provide default connections. These cut-traces allow the user to utilize the MCU output signals for other purposes if necessary.

Figure 11: CAN TX & RX Enable – JP6



RX	Enable / Disable CAN Rx Signaling
TX	Enable / Disable CAN Tx Signaling

Jp5
CAN

NOTE: In default configurations, both options are enabled by cut-trace and the option header is not installed.

LIN

The Local Interconnect Network (LIN) bus is a serial communications bus designed for automotive applications. The LIN specification is enforced by the LIN consortium and is currently at version 2.1. Similar to the CAN bus, the LIN bus supports lower data rates and fewer nodes. Also, the LIN bus operates only in Master – Slave mode with a single Master and one or more Slaves.

The MC9S12XHY256 provides basic support for the LIN protocol including break detect circuitry. The LIN module is implemented as part of the SCI module. Refer to the MC9S12XHY256 Reference Manual for details on use and configuration of the LIN module.

LIN Port

The Dashboard applies a MC33661 LIN transceiver provides the physical layer interface (PHY) to the LIN bus. The PHY is configurable for Master or Slave mode operation under software (SW) or hardware (HW) control. The MC33661 is configurable for 10kbps, 20kbps, or 100kbps data rates. The Dashboard is designed to allow the board to power the LIN bus or to be powered by the LIN bus. A 600W, 24V transient voltage suppressor (TVS) protects the PHY from input transients on the LIN bus.

Refer to the MC33661 Reference Manual for detail on PHY functionality. The following sections detail functionality for LIN option jumpers. Refer to the MC9S12XHY256 Reference Manual for details on configuring the MCU.

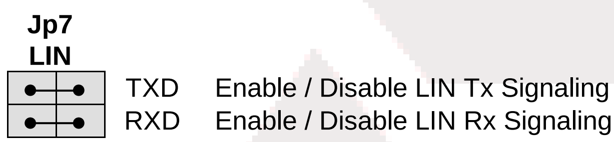
LIN Disable Option

LIN_DIS is routed to a test-point via located adjacent to the device. This input signal is pulled high by default to enable transceiver operation. Pull this input low to disable the LIN PHY

LIN TX & Rx Enable

JP6 connects the target MCU signals, PS0/RXD, and PS1/TXD, to the LIN transceiver. A cut-trace at this location provides default connection. An option header is not installed at this location in default configurations.

Figure 12: LIN TXD & RXD Enable – JP7



NOTE: In default configurations, both options are enabled by cut-trace and the option header is not installed.

LIN Wake

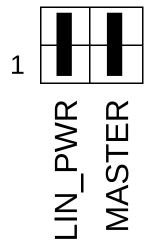
LIN wake is connected to the ignition switch, SW2, through a voltage divider. This allows the LIN bus to wake-up when the ignition switch is toggled. A WAKE pushbutton switch at SW3 is also provided to allow the user to create WAKE events.

LIN Power / Master Option Header

JP7 is a 2x2 option header allowing LIN bus configuration. Position 1 connects VIN from the input barrel connector to the LIN connector J10-3. This allows the Dashboard to source power to the LIN bus in Master mode or to sink power from the LIN bus in Slave mode. The Dashboard voltage input is protected in the event voltage input is lower than LIN bus voltage. This protection prevents damaging the input voltage source.

JP7, position 3, allow for hardware selection of master mode. Set this option jumper ON to force Master mode when the LIN PHY exits reset or awakens from Standby mode. Figure 13 below shows the selections available using option jumper JP7.

Figure 13: LIN Power / Master Option Header – JP7



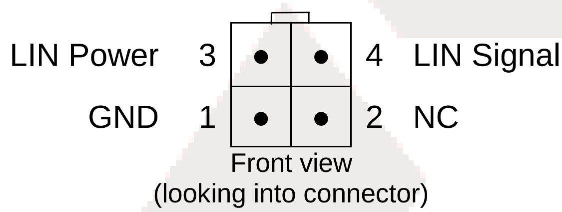
	ON	Off	
JP9	Enable	Disable	Enable / Disable LIN power
	Enable	Disable	Enable / disable LIN master select

LIN Connector

A Molex, Mini-Fit, 4-position connector at J3 connects the Dashboard to the LIN bus. This connector provides both signal and power connections. Figure 14 below shows the pin-out of the LIN connector as seen looking into the connector.

The LIN-J1 network connector provides a standard pin configuration with a network option position on pin 2.

Figure 14: LIN Connector – J11



NOTE: LIN Port Connector – Molex, 39-29-1048

Mates with; Housing – Molex, 39-01-2040, Pin – Molex, 39-00-0036

XHY256-DEMO-V1 PERIPHERALS

In addition to the peripherals noted above, the Dashboard applies several additional peripherals to simulate an automotive instrument panel. A loud-speaker, with volume control, is applied for audible alerts. Various LEDs are applied to simulate instrument panel indicator lights. Four momentary push-button switches are applied for user input. A user potentiometer at RV1 provides user analog input. A 2-position DIP switch input at SW1 (MODE) is provided for configuration input.

Loud Speaker

A loud-speaker with amplifier allows user applications to generate sound effects from the MC9S12XHY256 target. The amplifier generated frequencies between 300Hz to 10 KHz. The SPKR_VOL potentiometer provides speaker volume adjustment. Figure 15 below shows the speaker connections to the MC9S12XHY256

Figure 15: Speaker Input Signal

Speaker Input	PS7/PWM3

LEDs

Several LED groups are applied to simulate indicator light output on an automotive instrument cluster. Various colors are used. Each LED group consists of 2 LEDs in series to provide substantial light output. Figure 16 shows the LED control signal connections MC9S12XHY256.

Figure 16: LED Connections

LED Group	MC9S12XHY256 Signal	Color
LEFT	PR0/IOC0_6	Green
RIGHT	PR1/IOC0_7	Green
FUEL	PM0/IOC0_2	Yellow
FOG	PM1/IOC0_3	Yellow
TEMP	PM2/IOC1_2	Red
ENGINE	PM3/IOC1_3	Red
OIL	PAD8/AN8	Red
HI	PAD9/AN9	Blue

Push-Button Switches

The Dashboard applies 4, momentary, push-button switches for user input. Each push-button switch connects to GPIO pins MC9S12XHY256. Each push-button is active-low with external pull-up resistor for proper operation

Figure 17: Push-Button Switch Connections

Push-Button Switch	Reference Designator	MC9S12XHY256
MENU	SW7	PAD5/KWAD5
SELECT	SW6	PAD4/KWAD4
LEFT	SW9	PAD7/KWAD7
RIGHT	SW8	PAD6/KWAD6

Potentiometer

A 5k ohm, thumb-wheel type, potentiometer at RV1 provides variable resistance input for user applications. The output is the result of a voltage divider that changes as the thumb-wheel is turned. The potentiometer is connected between VDD and GND with the center tap providing the divider output. Figure 18 below details the user jumper settings and MCU connection.

Figure 18: User Potentiometer Connection

MC9S12XHY256
AN03

Input Voltage Monitoring

The MCU can be used to monitor input voltage, the 5VDC voltage rail, and the ignition switch input. Each signal is condition for monitoring by the MCU. Figure 19 below shows the input signals to the MCU.

Figure 19: Voltage Monitoring

Voltage	MCU Signal
Vin	PAD0/AN0
+5VDC	PAD2/AN2
IGN__SW	PAD1/AN1