LX4580 with SAMV71 MCU Demo User Guide

1 Description

This documents describes a demo linear actuator control system using the ATSAMV71Q21 microcontroller with an LX4580 motor acquisition system (Figure 1). The SAMV71 MCU runs the motor control loop and generates motor control signals, emulating the COM processor in a classic command/monitor (COM/MON) dual-controller control system such as shown in Figure 2. The LX4580 manages the sensors, in this case an LVDT and two temperature sensors. The LX4580 drives the LVDT primary directly, calculates the RMS of the two LVDT secondaries, and automates temperature sensing based on PT100 or PT1000 remote sensors.

The purpose of this project is to provide practical demonstration source code for a motor position control loop using an LVDT as a position feedback sensor, as the core of a larger control system. The motor drive hardware is simplified by using an off-the-shelf stepper motor controller, instead of using the LX4580's PWM controller outputs and current sense inputs.

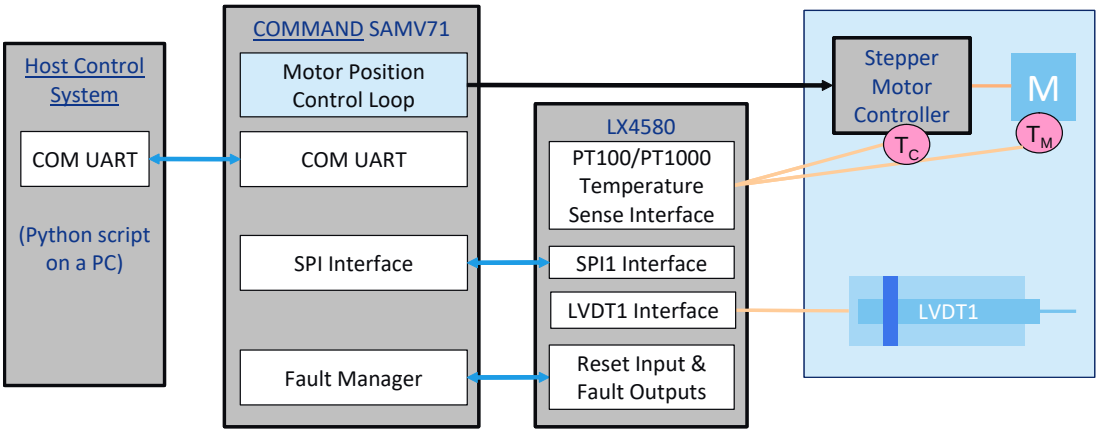


Figure 1. Demo Actuator Control System Block Diagram

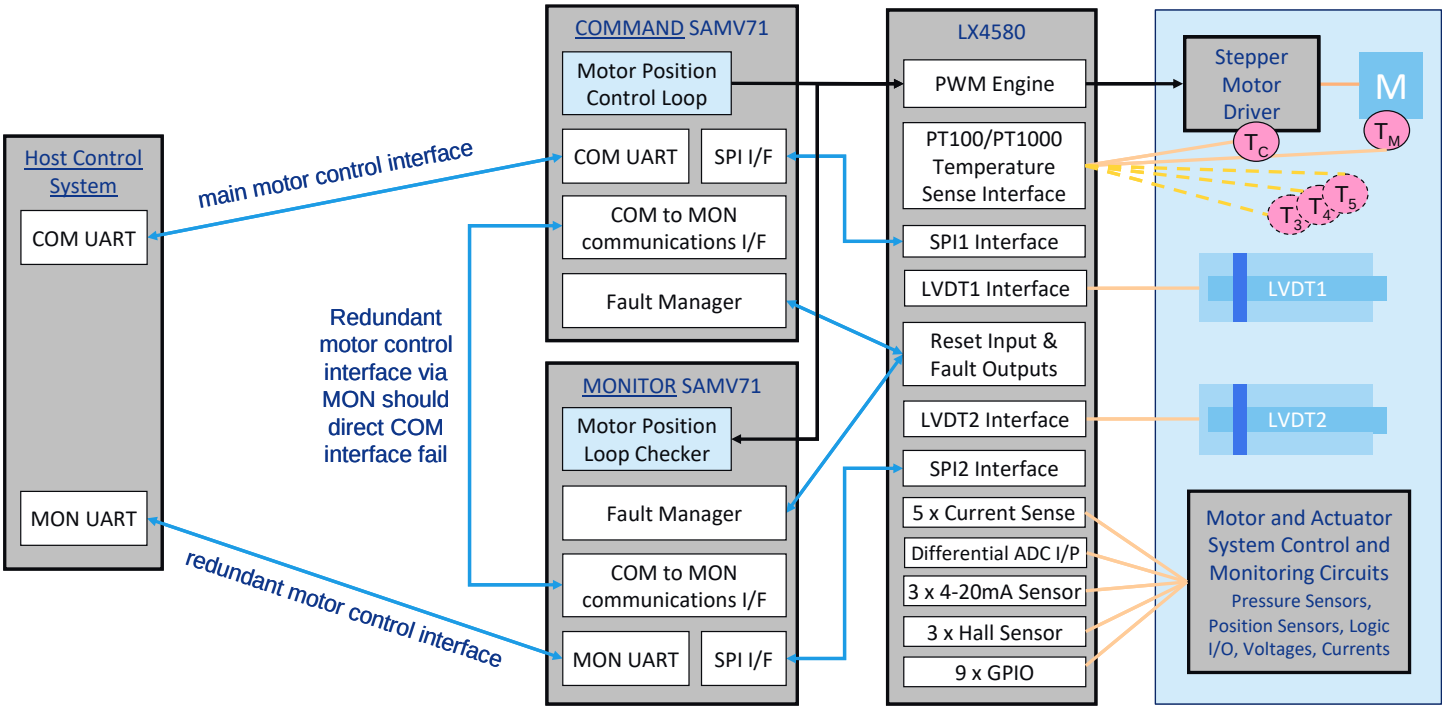


Figure 2. Typical COM/MON Motor Control System with Dual Processors and Redundant LVDTs

2 Demo hardware

The hardware comprises:

- An ATSAMV71-XULT SAMV71 Xplained Ultra evaluation kit, which carries an ATSAMV71Q21 MCU
- An LX4580 evaluation kit
- A Songhe TB6600 microstepping stepper motor driver. Alternative microstepping drivers with step/direction controls may be used, set to 8 microsteps (1600 steps per revolution) and 2.5A peak phase current
- A SainSmart 100mm linear stage actuator with NEMA17 stepper motor, operated at 15V
- A Solartron Metrology model 930982 S series LVDT
- Two PT100 or PT1000 thermistors
- Windows PC to act as system host

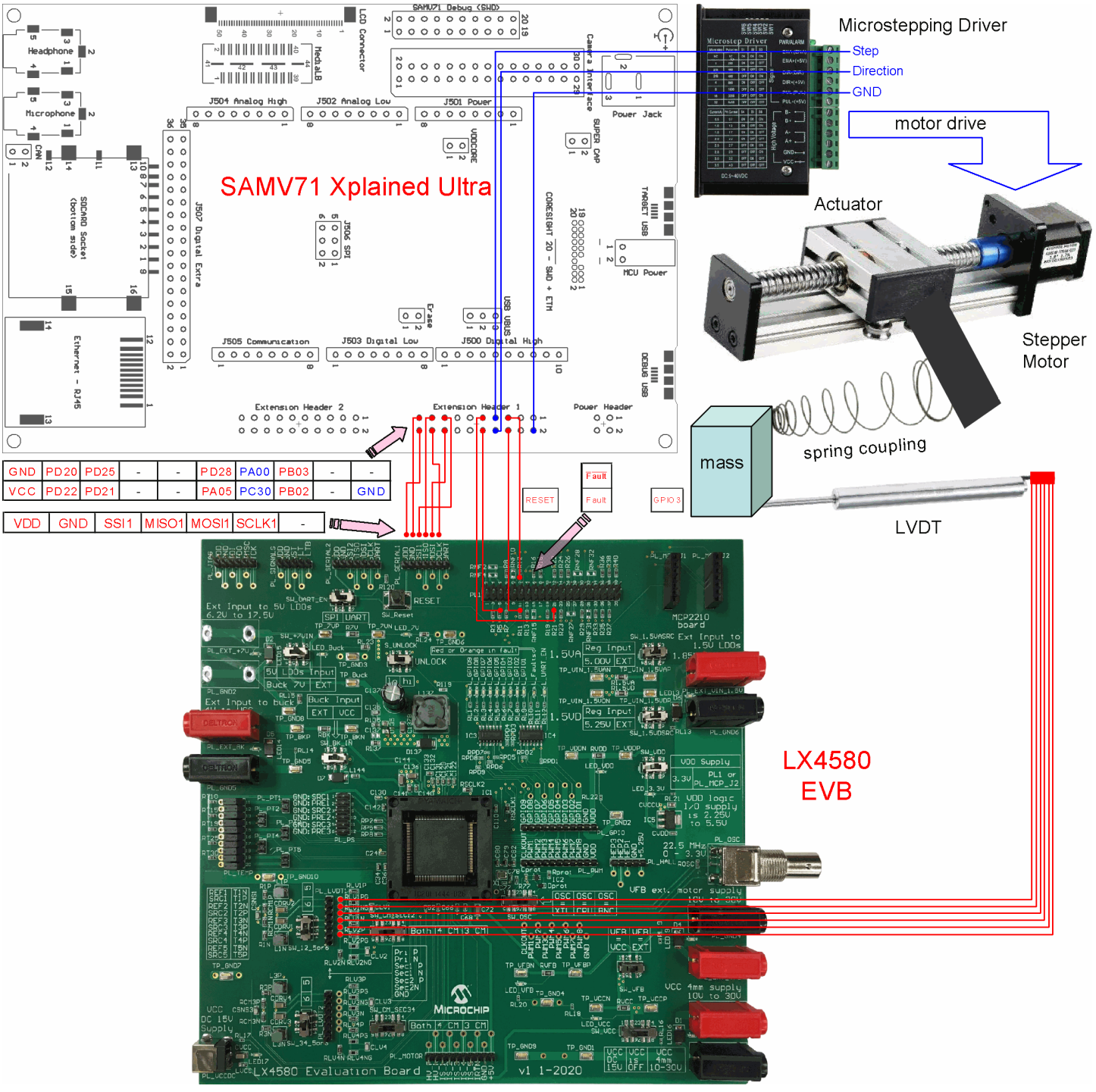


Figure 3. Demo System and Wiring Diagram

3 Control Loop

The control system is intended to emulate the real, complex dynamics of control surfaces in an airplane. The linear actuator is elastically coupled to a mass and the LVDT via a compression spring to exhibit substantial difference static and dynamic friction, as shown in Figure 3 on page 3. The position control loop is therefore 2nd-order to compensate.

4 Demo Software

The SAMV71 software is compiled on the MPLAB® Harmony embedded software development framework, and the source code is included as an attachment to this PDF. The system host is implemented in Python as a command-line script, which communicates to the SAMV71 Xplained board via USB. The necessary UART-over-USB driver is installed as part of the MPLAB® Harmony development installation for SAMV71, which is necessary to compile code and program the SAMV71.

The software set is as follows:

1. Download and install Python3 on your system if not already installed. We recommend the WinPython portable Python which includes the Spyder IDE, as discussed here
2. Download and install MPLAB® Harmony on your system if not already installed
3. The PDF contains the embedded file **LX4580-SAMV71.txt** stored as an attachment. Drag **LX4580-SAMV71.txt** with the left mouse button to your desktop, or right-click it and select a different destination
4. Rename **LX4580-SAMV71.txt** to **LX4580-SAMV71.zip** which is an encrypted zip file
5. Open **LX4580-SAMV71.zip**, and extract the two folders to your desktop or a different destination if preferred. This is an encrypted zip using **microchiptechnology** as the password. The **firmware** folder contains the SAMV71 source code. The **python** folder contains the host python scripts. There are no DLLs or other executables in folders

5 Interconnections

Table 1. Connections to SAMV71 Xplained board's Expansion Header 1

Pin	SAMV71	LX4580
1	-	-
3	-	-
5	PB03	PL1 pin 12 FAULT
7	PA00	Stepper controller STEP
9	PD28	PL1 pin 21 GPIO3
11	-	-
13	-	-
15	PD25	PL_SERIAL1 pin 3 SSI1
17	PD20	PL_SERIAL1 pin 4 MISO
19	GND	PL_SERIAL1 pin 2 GND

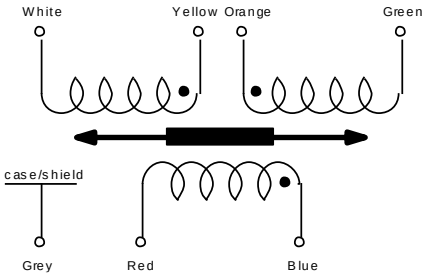
Pin	SAMV71	LX4580
2	GND	Stepper controller GND
4	-	-
6	PB02	PL1 pin 11 FAULT
8	PC30	Stepper controller DIR
10	PA05	PL1 pin 5 RESET
12	-	-
14	-	-
16	PD21	PL_SERIAL1 pin 5 MOSI
18	PD22	PL_SERIAL1 pin 6 SCLK
20	VCC	PL_SERIAL1 pin 1 VDD logic supply

Table 2. Temperature Sensor Connections to LX4580-EVB's PL_TEMP Header

Pin	Signal Name	Pin	Signal Name	Signal Function
1	TEMP1_REF	11	TEMP1_N	Connect pins1 and 11 to one terminal of Temp Sensor 1
2	I_TEMP1_SRC	12	TEMP1_P	Connect pins1 and 11 to the other terminal of Temp Sensor 1
3	TEMP2_REF	13	TEMP2_N	Connect pins1 and 11 to one terminal of Temp Sensor 2
4	I_TEMP2_SRC	14	TEMP2_P	Connect pins1 and 11 to the other terminal of Temp Sensor 2

Table 3. LVDT Connections to LX4580-EVB's PL_LVDT1 Header to Solartron Metrology 930982 LVDT

PL_LVDT1 Pin	Signal Function	Wire Color
1	Primary P	Red
2	Primary N	Blue
3	Secondary 1 P	White
4	Secondary 1 N	Yellow
5	Secondary 2 P	Orange
6	Secondary 2 N	Green
7	GND	Grey



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7 Revision History

7.1 Revision 0.1 - June 2021

Pre-release. Changes not logged.

7.2 Revision 1 - xxx 2021

First release.

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