The Model 50A offers power and remarkable design flexibility to even the most challenging motion control applications. With its double-wide IndustryPack (IP) configuration, the 50A provides four axes of DSP-based, servo motion control.

The 50A was created with a commitment to Tech 80’s open architecture design philosophy. With its industry-standard language support, programming is far easier than proprietary languages, and throughput isn’t slowed by lengthy ASCII transfers. Motion-specific function calls enhance standard languages, which enable ease of programming.

Its PMD’s 1401A DSP chipset is the heart of the Model 50A. The chipset handles the servo algorithms with PID and velocity feedforward filtering for all four axes. It performs the intensive computational tasks required for high performance applications such as digital velocity, torque and position control.

The 50A is part of Tech 80’s Modular Motion System™, a flexible multi-architecture (IP, PC, PC/104, VME) family of expansion modules and carrier boards that are designed for communications, industrial I/O, motion control, networking and many other applications. Supported by a number of key industry leaders, Tech 80’s Modular Motion System offers designers flexible and powerful solutions to meet their systems’ demands.

**Model 50A**
1-4 Axes
IndustryPack®
Servo Motion Controller

**PMD DSP Motion Control Chipset**

**PID with Velocity Feedforward Servo Control Loops**

**S-Curve, Trapezoidal & Velocity Motion Profiles**

**Open Architecture Software Library For C, C++, BASIC, Pascal, Visual Basic, Windows™ DLLs**

**16-Bit Analog (DAC) or 10-Bit PWM Command Signal Output**

**1.0 MHz Incremental Quadrature Encoder Input**

**Electronic Gearing Capabilities**
The Model 50A is ideally suited for PC-based OEM applications such as embedded machine control, packaging and semiconductor processing. The 50A has the power and flexibility demanded by many applications.

IndustryPack (IP) Design Flexibility
The IP form-factor has quickly become a leading expansion architecture due to its compact, flexible design and its acceptance by industry leaders such as Motorola. In addition to the 50A, Tech 80 provides a number of other IP modules and carrier boards for encoder interfacing, industrial I/O, servo and step motion control. From avionics to networking to video control, the 50A is easily incorporated with a wide variety of third-party vendor IP modules.

DAC & PWM Output Supported
The 50A can control each axis independently or synchronously. It outputs either analog (16-Bit DAC) or PWM command signals and provides for acceleration, position, velocity and jerk profile control.

Electronic Gearing Capabilities
Gearing allows for tight coordination between axes without taking up host processing time. The host specifies one parameter — the gear ratio. The target position for the slaved axis is generated by applying that ratio to the current position of the master axis and thus slaving the driven axis to the master encoder or axis.

Opportunity:
A factory customer designs large storage and retrieval systems for major manufacturers. These systems are designed to act as automated warehouses, capable of storing and recalling inventory on demand. These systems move materials within a single building, between buildings, and even between manufacturing facilities. This customer could not achieve the desired information & control throughput with the host computer alone. In addition, to achieve position accuracy, the customer needed the capability of laser positioning for the purpose of developing an error compensation table to correct for position error accumulation.

Analysis:
Inventory control, operator interface, report generation, and communication kept the host computer so busy that it could not control the storage and retrieval servos at the desired speed. This customer builds large systems that can contain over 24 axes of servo motion, and this does not include the other general conveyor mechanisms, elevators, operator input/output stations, switch tracks, or bar code readers.

The customer wanted to incorporate S-Curve motion profiling to reduce the system wear typically caused by trapezoidal moves. They also needed a dedicated CPU to handle all the direct servo control while having the host computer handle all the rest. On the dedicated CPU, dual position feedback was necessary — one for the encoder and one for the Laser.

Solution:
The customer considered two other boards for this application, but neither one offered the features needed. We recommended a Model 50A DSP Servo Controller with the Model 5643 Intelligent IndustryPack Carrier Board. Unlike Tech 80’s solution, neither board could access all on-board hardware ports without buying unnecessary options.

As part of the Modular Motion System™, the Models 50A and 5643 offered a simple, remarkably flexible solution. Their modularity allowed the needed hardware serial ports to be added for the laser and other I/O by way of mezzanine card expansion. Also, it could off load all motion decision-making processes from the host CPU and allow the host CPU to handle only the system overhead. The customer could also spend time and effort more wisely, writing more efficient software to allow the system to maintain its product throughput design goals.

These two features alone — binary language transfer and access to all on-board hardware ports — met all the customer’s needs and easily fit within their budget.
Tech 80 provides software drivers in BASIC, C, assembly language and Pascal. The dynamic linkable libraries (DLL’s) may be called from a variety of languages. Interrupt support is included.

Along with example code and templates, Tech 80 provides a number of software tools for developing applications with the Model 50A. A checkout program is useful for initial control configuration and test. With Intellitune™ servo motor tuning with the 50A is dramatically easier. The Modular Motion Toolkit™ offers a Windows-based interface to quickly incorporate the 50A onto Tech 80’s PC carrier boards.

**Tune Servo Motors Easily**

With Tech 80’s Intellitune software, tuning servo motors is no longer a time-consuming, difficult process. The program verifies factors such as motor resolution, amplifier operating mode and best acceleration to determine systems values and filter adjustments for tuning. Intellitune processes these values and uses them to help you tune the servo motors easily.

**Adjust & View System Functions In Windows**

The Modular Motion Toolkit includes graphical interfaces that help you access and edit parameters associated with Model 50A motion functions. A tuning display screen is included, eliminating the need for an oscilloscope. System response is graphically presented. The digital filter parameters (PID VFF) are adjustable and the results can be instantly viewed.

Optimized parameters may be saved and used in the actual application program. System configurations for multiple axes and boards are stored for future use.

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**50A Example Code: 4-Axes Motion Control**

This pseudo-code offers two examples of programming with the Model 50A. The first example demonstrates moves with a four-axis robotic arm application. The second is an example of changing the velocity at a given distance from the start. For more detailed example code please refer to Programming With Tech 80 Products.

**Example #1:**

**Initialize the 50A servo controller board**

```c
printf("Version = %x \n\", te50InitSw());
if (te50InitServo(B_ADDR, TE50TYPE_DAC16) != 0)
{printf("Board not responding\n"); return(0);}

Set axis
t50SetAxisMask(Board_Num, TE50AXIS_ALL);

Load the axis filter parameters
t50FilterPIDVF((KP , KI, KD, KV, KVFF , IL);
t50SetAxis(Boad_Num, AxisX);
t50ProfileTrap(PosX, VelX, AcelX);
t50SetAxis(Boad_Num, AxisY);
t50ProfileTrap(PosY, VelY, AcelY);
t50SetAxis(Boad_Num, AxisZ);
t50ProfileTrap(PosZ, VelZ, AcelZ);
t50SetAxis(Boad_Num, AxisW);
t50ProfileTrap(PosX, VelW, AcelW);
```

**Example #2:**

**Initialize the 50A servo controller board**

```c
printf("Version = %x \n\", te50InitSw());
if (te50InitServo(B_ADDR, TE50TYPE_DAC16) != 0)
{printf("Board not responding\n"); return(0);}

Set axis
t50SetAxisMask(Board_Num, TE50AXIS_ALL);

Load the axis filter parameters
t50FilterPIDVF(KP, KI, KD, KV, KVFF, IL);
t50SetAxis(Board_Num, TE50AXIS_1);

Load the axis filter parameters
t50FilterPIDVF(KP, KI, KD, KV, KVFF, IL);
t50Update();
t50ProfileTrap(PosX, VelX, AcelX);
t50Update();
t50AutoUpdateOn();
```

**Setup to change Velocity at a breakpoint**

```c
t50SetBrkActlPosn; (PosX, VelX, AcelX);
```

while(!t50IsBreakpoint());

---

Checkout provides users all information in this easy-to-read GUI.

A programmable error limit generates an interrupt when an excessive difference between actual and commanded position occurs. S-Curve and trapezoidal motion profiles are supported.
Initializations & Configuration Routines

- te50AutoUpdateOff
- te50AutoUpdateOn
- te50AxisOff
- te50AxisOn
- te50CaptureHome
- te50CaptureIndex
- te50DrvDevOff
- te50DrvDevOn
- te50FilterPIDVFF
- te50HomePol
- te50InitServo
- te50InitSw
- te50LimitsOff
- te50LimitsOn
- te50LimitPol
- te50MotorOff
- te50MotorOn
- te50PhasesPol
- te50PhasesSwOff
- te50PhasesSwOn
- te50SetAxis
- te50SetAxisMask
- te50SetResolution
- te50SetSampleTime

Motion Profile Routines

- te50ProfileComplete
- te50ProfileSCurve
- te50ProfileTrap
- te50ProfileVel
- te50RelPos
- te50SetAcc
- te50SetJerk
- te50SetMaxAcc
- te50SetPos
- te50SetProfile
- te50SetRatio
- te50SetVel

Servo Command Routines

- te50AxisOn
- te50BreakPointOff
- te50GetMotorBias
- te50GetLimit
- te50GetNegLimit
- te50GetPosErr
- te50GetPosLimit
- te50GetPosRec
- te50GetResetBoard
- te50GetResetCapture
- te50GetResetEvents
- te50GetStatus

Read Back Routines

- te50GetAcc
- te50GetBreakPoint
- te50GetIntrMask
- te50GetJerk
- te50GetMaxAcc
- te50GetMode
- te50GetMotorLimit
- te50GetMotorCmd
- te50GetPIDVFF
- te50GetPos
- te50GetPosErr
- te50GetPosRec
- te50GetSampleTime
- te50GetVel
- te50GetSampleTime
- te50GetSampleTime
- te50GetStatus

Interrupt Routines

- te50DisableIRQ
- te50EnableIRQ
- te50HookIntr
- te50IntrActive
- te50IsWrapAround
- te50MaskInterrupt
- te50UnmaskIntr
- te50VelsZero

Conversion Routines

- te50CvAcc
- te50CvJerk
- te50CvPos
- te50CvVel

Data Reporting Routines

- te50ActPos
- te50ActPosErr
- te50CapturePos
- te50CurAxis
- te50CurPos
- te50CurVel

Data Reporting Routines Con't

- te50CurAxisMask
- te50CurBoard
- te50DesPos
- te50DesVel

The 50A software includes all of the following routines. Below is the functional and alphabetical listing of the drivers and constants with a description of each. For more information regarding programming and software, please refer to the Programming with Technology 80 Products.
Model 50A on a Model 5641 Carrier Board

Typical Jumper Configuration

<table>
<thead>
<tr>
<th>Position</th>
<th>W1</th>
<th>W3</th>
<th>W4</th>
<th>W5</th>
<th>W6</th>
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<td>Shorted</td>
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<td>Shorted</td>
<td>Shorted</td>
<td>Shorted</td>
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</table>
### Specifications

**Host Interface:**
- IP Compatible Carrier Board
- I/O Mapped Switch-Selectable Address
- 8-Bit Data transfers
- Programmable Interrupts
- High-Speed Binary Communications

**Recommended Operating Environment:**
- 0 - 70 °C
- 20 - 95% Relative Humidity, Noncondensing

**Servo Loop/Trajectory Update Rate:**
- 2.5 KHz Default (4 Axes Enabled)
- 10 KHz Maximum (1 Axis only)
- User-Programmable: 100 µsec. to 3.3 sec.

**Servo Output:**
- Analog (DAC) @ 16-Bit Resolution
- PWM @ 10-Bit Resolution

**Motion Profiles (Axis Independent):**
- Velocity
- Gearing
- Trapezoidal
- S-Curve

**Controller Chipset:**
PMD MC1401A:
- 25 MHz DSP
- Custom ASIC

**Position Feedback:**
Incremental Quadrature Encoder:
1.0 MHz, Differential or Single-Ended Count Frequency

**Motion Ranges:**
- Position: ± 1.073 Billion Counts
- Velocity: 0 - 16,384 Counts/Sample Time² (Res. 1/65K)
- Acceleration: S-Curve: ± 0.5 Counts/Sample Time² (Res. 1/65K)
  All Others: ± 16,384 Counts/Sample Time² (Res. 1/65K)
- Jerk: 0 - 0.5 Counts/Sample Time³ (Res. 1/65K)
  (S-Curve only)

**Interrupts (Per Axis):**
- Controller Ready
- Time/Position Breakpoints
- Trajectory Complete
- Excess Following Error
- Index/Home Capture

**Board Dimensions:**
3.6 x 3.9 x 0.6” (9.2 x 10.0 x 1.5 cm)

**Power Requirements:**
- +5.0 VDC: ± 5% 1.1 Amp
- +12 VDC: ± 10 mA
- -12 VDC: ± 10 mA

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**Ordering Information**

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<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>50A</td>
<td>1-4 Axes Servo Motion Controller</td>
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<tr>
<td>50A DEV</td>
<td>Development Kit</td>
</tr>
<tr>
<td>50A MAN</td>
<td>Hardware &amp; Software Manuals*</td>
</tr>
<tr>
<td>50A SOFT</td>
<td>Demo &amp; Driver Software*</td>
</tr>
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</table>

* Included in the Development Kit along with Motor Sizing Software, Designing with Motion Handbook, and discount on 9011 Motion Simulator

**Warranty**

This product is warranted according to the Terms and Conditions of Sale and is effective for TWO YEARS AFTER SHIPMENT from Technology 80 Inc. For further warranty information, please consult the hardware manual.

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