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# Embedded Motion Controller

## GU Series

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*Low Cost High Reliability*

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## COMPANY PROFILE

Googol Technology (HK) Limited was founded in 1999 by a group of renowned experts, academics and professionals in motion control, manufacturing automation and microelectronics. As the first high-tech company in Asia Pacific region specializing in motion controllers and controller based systems, Googol Technology offers a range of standard and highly customized motion controllers, PA-based control systems as well as automation and mechatronics products. Regional application engineering expertise, strong support, cost effectiveness, and high performance set Googol Technology apart from all others.



Googol Technology (HK) Ltd, the headquarter office, is located at Hong Kong University of Science & Technology.



Googol Technology (SZ) Limited is located at the Hi-Tech Industrial Park in Shenzhen, China

### **Mission**

To provide high-performance and cost-effective motion control systems for the market

### **Objectives**

To become a leading provider of innovative motion control products and service to the clients, and to contribute the development of the region as a world-class manufacturing base in electronics and IT products.

### **Products and Services:**

#### **Motion controllers**

- GH/GT/GE/GO series standard motion controllers
- Special-purposed motion controllers
- GN series network based motion controllers
- GU series embedded motion controllers
- PC-based and CNC control systems
- Control system development platforms
- OEM/ODM services

#### **Education products**

- Experiment equipments for motion control theoretical research and control engineering;
- Equipments for automation control, robotics and mechatronics
- Process control systems and facilities
- Logistic automation systems
- Flexible manufacturing systems (FMS)

## **EMBEDDED MOTION CONTROLLER DESCRIPTION**

### **Overview**

An embedded motion controllers newly developed by Googol Technology is a stand-alone motion controller. It was made by plugging the embedded PC104 main board onto the Googol's open-architectural motion control board to form a single unit. It is highly reliable, easy to upgrade and maintain due to the fact that the motion control board and the PC are connected by pin insertion, they are tightly joined, and mutually independent. Such a perfect combination of industrial PC and motion controller into one unit gets rid of system instability from using slot connection, all functions of motion controller are maintained at the same time. In comparison with the PC plug-in motion controller, the embedded system shows the advantages of high reliability under humid, dusty, vibrated and magnetic industrial environments, and lower customer cost because no extra PC is needed. It can be used as an ideal CNC development platform for many kinds of industrial applications such as PCB drilling, engraving, laser applications etc.



Embedded Motion Controller

### **Main Features**

- Use of high performance DSP, FPGA technology and embedded PC104 main board PC
- Compatible with any Googol general purposed or specialized motion controllers,
- Contain full functions of Googol motion controllers
- Each can control up to 4 servo or stepping motors
- Support DOS, Win CE, Linux operation system
- Provide multiple interfaces including USB, COM, Ethernet, DNC, expanded I/O, control panel, touch screen, keyboard, and mouse for easy development troubleshooting and expansion
- Have the advantages of high reliability under humid, dusty, vibrated and magnetic industrial environment over conventional PC plugged-in motion controllers
- Lower customer cost since no PC is needed
- Lower consumption (no fan is needed)
- Easy to maintain since there is no mechanical parts

### **Technical Specifications**

Modes of motion:



- point-to-point,
- linear interpolation,
- circular interpolation,
- velocity control,
- manual pulse generator input and electronic gearing

### **Control Input/Output**

- 4 channels of 16-bit analog voltage output signal or pulse output signal with a frequency up to 1MHz.
- 4 channels of quadrature incremental encoder input (A+, A-, B+, B-, C+, C-)

### **System Software**

- Windows CE/DOS/Linux attachment drivers
- Motion controller display procedure

### **Digital Input/Output**

- 8 ~16 channels of uncommitted opto-isolated digital input
- 8 ~16 channels of uncommitted opto-isolated digital output

### **Dedicated Digital Input/Output**

- Dedicated opto-isolated input per axis, 8 channels for limit switch signal, 4 channels for home signal, and 4 channels for drive alarm signal input.
- Dedicated opto-isolated output per axis, 4 channel for drive enable signal, and 4 channel for drive alarm signal reset

### **Bus Type**

- Standard PC/104 bus

### **Mechanical Dimension**

- L x W x H: 300mm x 176mm x 67.5mm

### **Power Requirement**

- +24V, ICC=2A; external power provided by users is required

### **Condition Requirement**

- Working temperature: 0 ~ +60°C
- Relative humidity: 5% ~ 90% condensation free



## System Configuration

- GE series or GT series motion controller (2, 4 axes, made-to-order)
- CPU Main board
- Standard accessories including terminal board, connection cables
- System software and control software
- Options including drives and motor connection cables, touch screens, etc



Terminal board



Cables



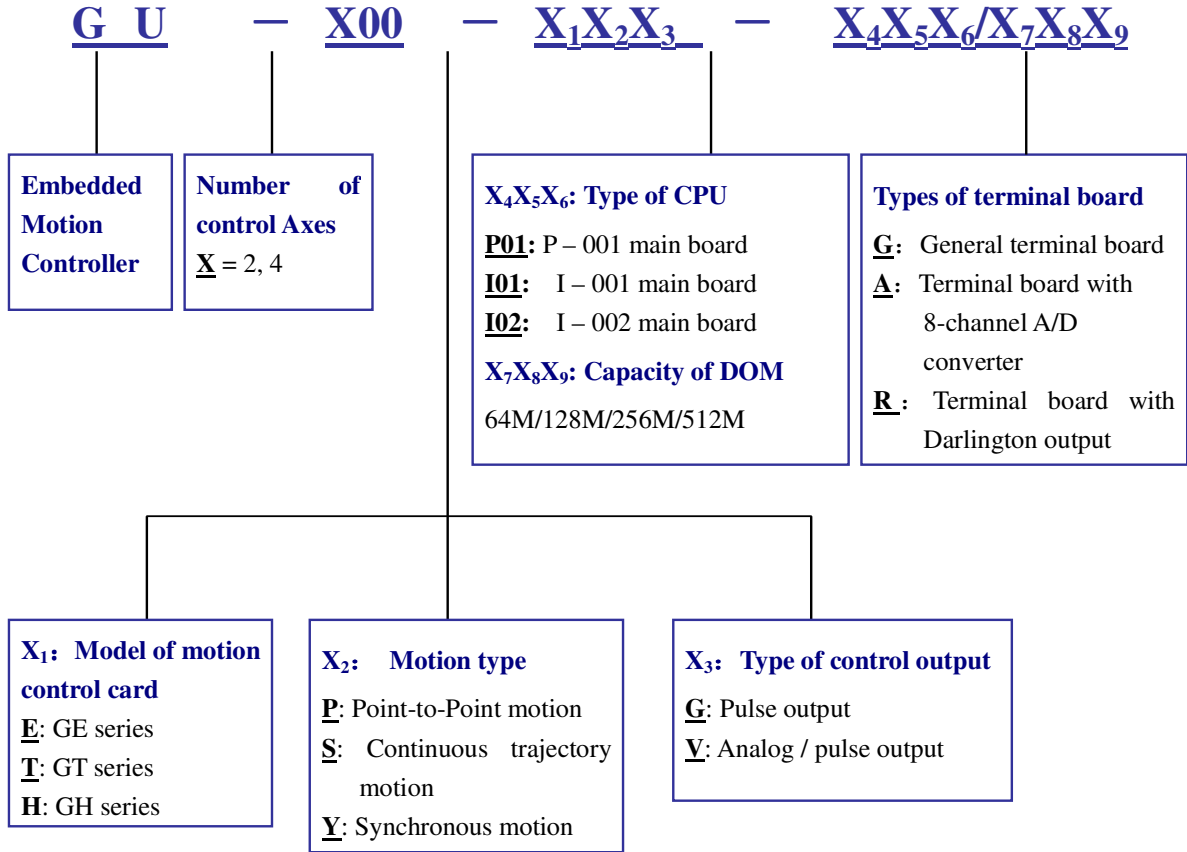
Touch screen



# TERMINOLOGY OF GU SERIES EMBEDDED MOTION

## CONTROLLERS

### Nomenclature:



### Sample:

**GU – 200 – ESV – I02 / 128 – G**

- GU:**      Embedded model
- 200:**     Axis = 2
- ESV:**     GE series motion control card; Continuous trajectory motion; Analog / pulse output
- I02 / 128:** I-002 main board with 128M DOM
- G:**        General terminal board



## GU SERIES MOTION CONTROLLERS FAMILY

Product Series	Product Type	Number of Axes	Embedded Controller main board and DOM Capacity
<b>GU Series Embedded Motion Controller</b>	GU-X00-ESG -X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> /128	2/4 axes	GU Embedded Motion Controller with GE-X00-SG motion control function X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> = I01: I01 Type CPU I02: I02 Type CPU P01: P01 Type CPU DOM—128M
	GU-X00-ESV -X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> /128	2/4 axes	GU Embedded Motion Controller with GE-X00-SV motion control function X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> = I01: I01 Type CPU I02: I02 Type CPU P01: P01 Type CPU DOM—128M
	GU-X00-EPG -X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> /128	2/4 axes	GU Embedded Motion Controller with GE-X00-PG motion control function X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> = I01: I01 Type CPU I02: I02 Type CPU P01: P01 Type CPU DOM—128M
	GU-X00-EPV -X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> /128	2/4 axes	GU Embedded Motion Controller with GE-X00-PV motion control function X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> = I01: I01 Type CPU I02: I02 Type CPU P01: P01 Type CPU DOM—128M
	GU-X00-TSV -X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> /128	2/4 axes	GU Embedded Motion Controller with GT-X00-SV motion control function X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> = I01: I01 Type CPU I02: I02 Type CPU P01: P01 Type CPU DOM—128M
	GU-X00-TSG -X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> /128	2/4 axes	GU Embedded Motion Controller with GT-X00-SG motion control function X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> = I01: I01 Type CPU I02: I02 Type CPU P01: P01 Type CPU DOM—128M

Technical Details please refer to 《User's Guide for GU Series Motion Controller》



## SPECIFICATIONS OF GU SERIES MOTION CONTROLLER

### Motion Control Mode Specifications:

Position	GU – X00 – X <sub>1</sub> X <sub>2</sub> X <sub>3</sub> – X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> /X <sub>7</sub> X <sub>8</sub> X <sub>9</sub> – X	
Mode	Definition	Description
<b>ESV</b>	Continuous Trajectory Motion Analogy/Pulse output	Multi-segments continuous trajectory motion. Provide analogy and pulse output. Suitable for users that require realizing high quality trajectory motion control. Can be applied to CNC system such as engraving machine.
<b>ESG</b>	Continuous Trajectory Motion Pulse output	Multi-segments continuous trajectory motion. Provide pulse output to motor driver. Suitable for users that require to realize high quality trajectory motion control. Can be applied to CNC systems such as engraving machine.
<b>EPV</b>	Point-to-point motion Analogy/pulse output	Multi-axis point-to-point motion. Provide analogy and pulse output. Suitable for users that require to realize multi-axis point-to-point motion control. Can be applied to systems such as drilling machine.
<b>EPG</b>	Point-to-point motion Pulse output	Multi-axis point-to-point motion. Provide pulse output. Suitable for users that require to realize multi-axis point-to-point motion control. Can be applied to systems such as drilling machine.
<b>TSV</b>	Continuous Trajectory/ Point-to-point motion Analogy/pulse output	Multi-axis interpolation and point-to-point motion. Provide analogy and pulse output. Suitable for users that require to realize both multi-axis interpolation and point-to-point motion control. Can be applied to several industrial environments such as milling & drilling machine.
<b>TSG</b>	Continuous Trajectory/ Point-to-point motion Pulse output	Multi-axis interpolation and point-to-point motion. Provide pulse output. Suitable for users that require to realize both multi-axis interpolation and point-to-point motion control. Can be applied to several industrial environments such as milling & drilling machine.

### Axis Specifications:



Position	GU – X00 – X <sub>1</sub> X <sub>2</sub> X <sub>3</sub> – X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> /X <sub>7</sub> X <sub>8</sub> X <sub>9</sub> – X	
Number of Axes	Definition	Description
200	2 axes	2 axes point-to-point control or 2 axes coordinated interpolation control can be realized by using 2 axes embedded motion controller. Typical application: XY-table, cutting machines. Selection of point-to-point or continuous trajectory control is decided by the number X <sub>1</sub> X <sub>2</sub> X <sub>3</sub> .
400	4 axes	4 axes point-to-point control or 4 axes coordinated interpolation control can be realized by using 4 axes embedded motion controller. Typical application: 3-D engraving machines, 3-D CNC platform. Selection of point-to-point or continuous trajectory control is decided by the number X <sub>1</sub> X <sub>2</sub> X <sub>3</sub> .

**Terminal board Type:**

Position	GU – X00 – X <sub>1</sub> X <sub>2</sub> X <sub>3</sub> – X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> /X <sub>7</sub> X <sub>8</sub> X <sub>9</sub> – X	
Type	Definition	Description
G	Standard	Standard interface configuration (Motor control axis, uncommitted 16 channel digital input/output, limit and home switch input, auxiliary encoder input)
A	A/D Converter	Standard interface configuration, with A/D modular, up to 8 channel analog input.
R	Darlington Output	Standard interface configuration, with power amplifier, IO output actuate extension relay, Max. Output current 300mA

## CPU MAIN BOARD CONFIGURATION LIST

Board Model		I-001	I-002	P-001
CPU Clock Speed		166MHZ	133MHz	100MHZ
RAM on board		128M	64M	1M
Display		VGA Display Interface	VGA Display Interface	LVDS Display Interface
Connecting Interface	USB	2 Channels	2 Channels	1 Channel
	COM	2 Channels	2 Channels	4 Channels
	Ethernet	10/100M	No	10/100M
	Keyboard	PS2 Industrial Keyboard Interface	PS2 Industrial Keyboard Interface	PS2 Industrial Keyboard Interface
	Mouse	Yes	No	No
Others				Built-in 1.44M Flash Drive
Optional DOM		64M/128M/256M/512M	64M/128M/256M/512M	64M/128M

## FUNCTION LIST

✓ **Included**      — **Excluded**      \* **Optional**

GU Embedded Series Features		ESV	ESG	EPV	EPG	TSV	TSG
Bus	PC104	✓	✓	✓	✓	✓	✓
Sampling rate	200us	✓	✓	—	—	*	*
	400us	—	—	✓	✓	*	*
	User adjustable	—	—	—	—	✓	✓
Analogy output	Range: -10V~+10V	✓	—	✓	—	✓	—
Pulse output	+/- Pulse, Step + Pulse	✓	✓	✓	✓	✓	✓
	Max. Output Frequency: 256KHz	✓	✓	—	—	—	—
	Max. Output Frequency: 1MHz	—	—	✓	✓	✓	✓
Encoder channel	Quadrature incremental encoder. Max. Counting Frequency: 8MHz.	✓	✓	✓	✓	✓	✓
Auxiliary encoder	2 channels of quadrature incremental encoder.	1 Channel	1 Channel	✓	✓	✓	✓
Limit switch	Left and right limit switch of each axis.	✓	✓	✓	✓	✓	✓

Home switch	Home switch of each axis	√	√	√	√	√	√
Driver alarm signal	1 channel of driver alarm signal of each axis	√	√	√	√	√	√
Driver enable signal	1 channel driver enable signal of each axis	√	√	√	√	√	√
Driver reset signal	1 channel driver reset of each axis	√	√	√	√	√	√
Uncommitted digital input	16 channels	√	√	√	√	√	√
Uncommitted digital output	16 channels	√	√	√	√	√	√
Watchdog	Monitor DSP work status in real time.	√	√	√	√	√	√
Interpolation motion	Linear and circular interpolation	√	√	—	—	√	√
Point-to-point motion	S-curve, T-curve and jogging motion modes	—	—	√	√	√	√
Program memory	8K, Multi-segment look ahead function	√	√	—	—	—	—
	4K, Two segments look ahead function	—	—	—	—	√	√
Data Monitor	Detect channel data in real time	√	√	√	√	√	√
Encoder single end input	Auxiliary encoder and axis encoder	*	*	*	*	*	*
Filter	PID + Velocity Feed forward+ Acceleration Feed forward	√	—	√	—	√	—
Hardware capture	Index signal of encoder	√	√	√	√	√	√
	Home switch	√	√	√	√	√	√
Safety	Following error limit.	√	—	√	—	√	—
	Acceleration limit.	√	√	√	√	√	√
	DAC output limit.	√	—	√	—	√	—
CPU board	P01, DOS6.22 operation system	*	*	*	*	*	*
	I01, DOS7.1 or WINCE	*	*	*	*	*	*
	I02, DOS7.1 or WINCE	*	*	*	*	*	*
DOM	64M/128M/256M/512M	*	*	*	*	*	*

Embedded motion controller integrates PC to motion control board. The basic motion control functions depend on the integrated motion control board. WINCE system cannot be installed to P series main board.



## COMPARISON BETWEEN EMBEDDED AND PC BASED MOTION CONTROLLERS

Googol standard embedded motion controller is mainly based on our motion control board GE-SX, GE-PX and GT-SX series. Different control series have different function to provide solutions that satisfy various customer requirements.

### **Comparison between embedded motion controller and the same type PC based motion controller:**

	Embedded Motion Control Systems	PC Based Motion Control Systems
Motion control function	With standard motion control function based on specified series	With standard motion control function based on specified series
Motion controller and operating system interface	Connected tightly by industrial PC104 contact pin, more reliable than PC plugged in. Hard to disassemble or assemble.	Connected by PCI or ISA slot in PC. Easily to get loose or make the gold finger dirty when moving PC, which result in poor contact.
Operating System	DOS or WINCE , microkernel embedded operating system, with simpler structure and function, more stable than PC based WIN98, WIN2000 system when operating.	WIN98 or WIN2000 system based on PC. Powerful operating system, easy to exchange and maintenance data, user-friendly interface. PC operating system is more open to user.
CPU	X86 Industrial CPU. Basic frequency is lower than general-purpose PC.	Popular CPU chips in the market. Basic frequency up to several Gigabytes. Powerful CPU can be used for complex computation and other applications.
Peripherals	Support standard peripherals.	Support standard peripherals.
Software development and debug	Software development and debugging for embedded controller are more complicated than PC based controller. User should develop software on PC first and then download to the embedded motion controller to debug. User may also develop and debug long distance via internet. Only TC, BC (DOS operating system) and EVC (WINCE operating system) are	Software development and debugging are relative simple. Motion controller will be plugged in the PC for real-time development Many sorts of software can be used as development environment: TC, BC, VC, VB, DELPHI, etc.

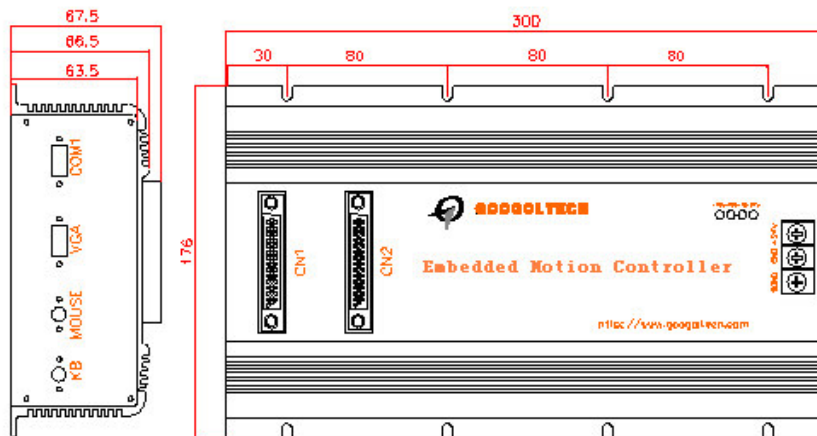
	recommended as the software environment, which propose higher requirement to the programmer.	
DOM Memory	Tens of Megabytes to hundreds of Megabytes. Memory is relative low.	Usually has large memory up to tens of Gigabytes.
Anti-disturbance, stability	Embedded controller integrates industrial PC and motion controller, each part is connected tightly by screws. It has higher anti-disturbance feature and higher stability.	PC is less stable to vibration and disturbance than embedded systems for the reason of unreliable grounding, operating system, heat dissipation, etc.
Installation Specifications	Small occupation, more convenient for installation and carry.	Relative large space required for installation than embedded motion controller.
Price	Lower price than PC plus PC based motion controller	

## STRUCTURE AND SIZE

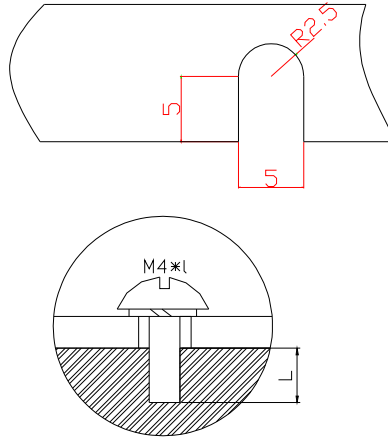
Googol GU embedded series has small size; the occupation reduced about 50% than traditional industrial personal computer. The controller should be vertically installed in the installation process.

The cover of the embedded controller is made by metal, each part is connected tightly by screws. Embedded motion controller is suitable for working in many kinds of industrial environment because of its small size, compact construction, high anti-vibration and interference killing feature.

Embedded motion controller structure and size (300×176×67.8mm) :



**Fig.1.1 Embedded motion controller structure and size**

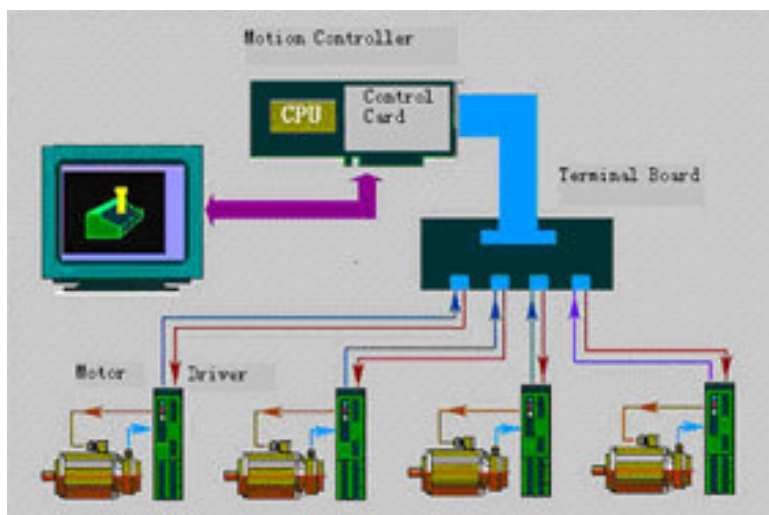


**Fig.1.2 Embedded motion controller installation structure and size**

The screw depth L should be larger than 4mm when installing embedded controller.

## **EMBEDDED CONTROL SYSTEM CONFIGURATION**

1. Embedded motion controller;
2. Motion control terminal board;
3. Step or servo motor (AC or DC)
4. Motor driver;
5. Power supply (motor driver power, motion controller power, terminal board power, etc) ;
6. I/O Signal (Home switch, positive/ negative limit switch, optional as needed) ;
7. Mechanical body.



**Fig.1.3 Schematic Diagram of Motion Control system using embedded motion controllers**

Embedded motion controller typical application, see Fig.1.4:

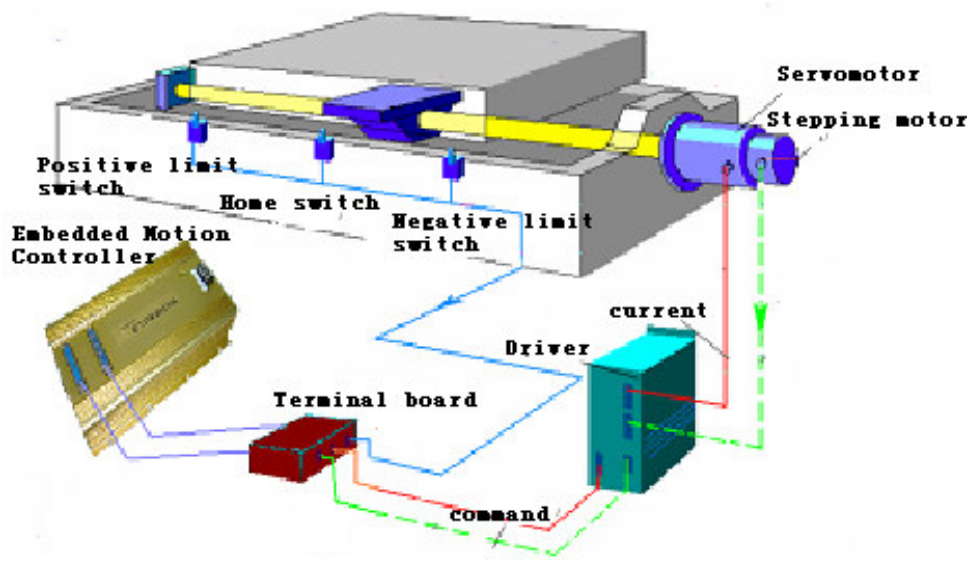


Fig.1.4 Typical application of embedded motion controllers





# CUSTOMER ORDER FORM FOR EMBEDDED MOTION CONTROLLER

Please complete in block letters.

## (I) Company Information:

Name: \_\_\_\_\_ Position: \_\_\_\_\_

Company Name: \_\_\_\_\_

Company Address: \_\_\_\_\_

Telephone: \_\_\_\_\_ Fax: \_\_\_\_\_

E-Mail Address: \_\_\_\_\_ Company Web Site: \_\_\_\_\_

Company Nature: \_\_\_\_\_

System Integration       Manufacturing       Trading

Other, please specify: \_\_\_\_\_

## (II) Model Information:

The model type ordered is

**GU - \_\_ 00 - \_\_\_\_\_ - \_\_\_\_\_ / \_\_\_\_\_ - \_\_**

### (II)-1 Motion Control Module: (For detail, please refer to GE or GT series motion control board)

<b>Number of Axes:</b>	
<input type="checkbox"/> 2 Axes	<input type="checkbox"/> 4 Axes
<b>Module Type:</b>	
<input type="checkbox"/> ESG	<input type="checkbox"/> ESV
<input type="checkbox"/> EPG	<input type="checkbox"/> EPV
<input type="checkbox"/> TSG	<input type="checkbox"/> TSV

### (II)-2 CPU Board

<b>CPU Type:</b> (For detail, please refer to PC104 Main Board Configuration List)		
<input type="checkbox"/> P-001 Main Board	<input type="checkbox"/> I-001 Main Board	<input type="checkbox"/> I-002 Main Board
<b>Capacity of DOM:</b>		
<input type="checkbox"/> 64M	<input type="checkbox"/> 128M	<input type="checkbox"/> 256M <input type="checkbox"/> 512M



**(II)-3 Operation System**

DOS

WinCE

**(III) Type of Terminal Board and Other Options:**

**Terminal Board:** (For detail, please refer to Order Information Section)

G

A

R

**Display**

Touch Screen

Yes

No

**Cable Length**

1.5m

3.0m

Other

If you choose other, please specify length you required:

**(IV) Other Information:**

**Your Applications:** (Your information will help us provide better consulting)

**Your Suggestions:**

**Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Please fax to (852) 2719 8399 or scan and email to [sales@googoltech.com](mailto:sales@googoltech.com) upon completion and signing of the form.**

Googol Technology (HK) Ltd. will take full responsibility of keeping the customer information confidential. The above information will be used as a reference for the technical support service only, will not be used for any other purposes or be disclosed to any other parties without prior permission from the customer.