Low Noise 256 Subdivision Microstepping Motor Drive

Product Description

The MS35775 is a high-precision, low-noise, two-phase stepper motor driver. The MS35775 integrates a fast mode and a quiet mode to meet the needs of both high and low speeds.

Different applications. With built-in power MOSFET, the average current can reach 1.4A for long time operation and the peak current is 2A. The chip integrates over-temperature protection, under-voltage protection, over-current protection, short-ground protection, and short-supply protection.

Main features

- 2-phase stepper motors, capable of 2A peak current
- low ON-resistance
- Voltage range 4.75~36V
- STEP/DIR interface, selectable from 2, 4, 8, 16, or 32 microsteps
- Internal 256 breakdown
- Motor stationary automatically enters power saving mode
- Built-in detection resistor mode selectable (external detection resistor no longer required)
- QFN28 package (backside heat sink)

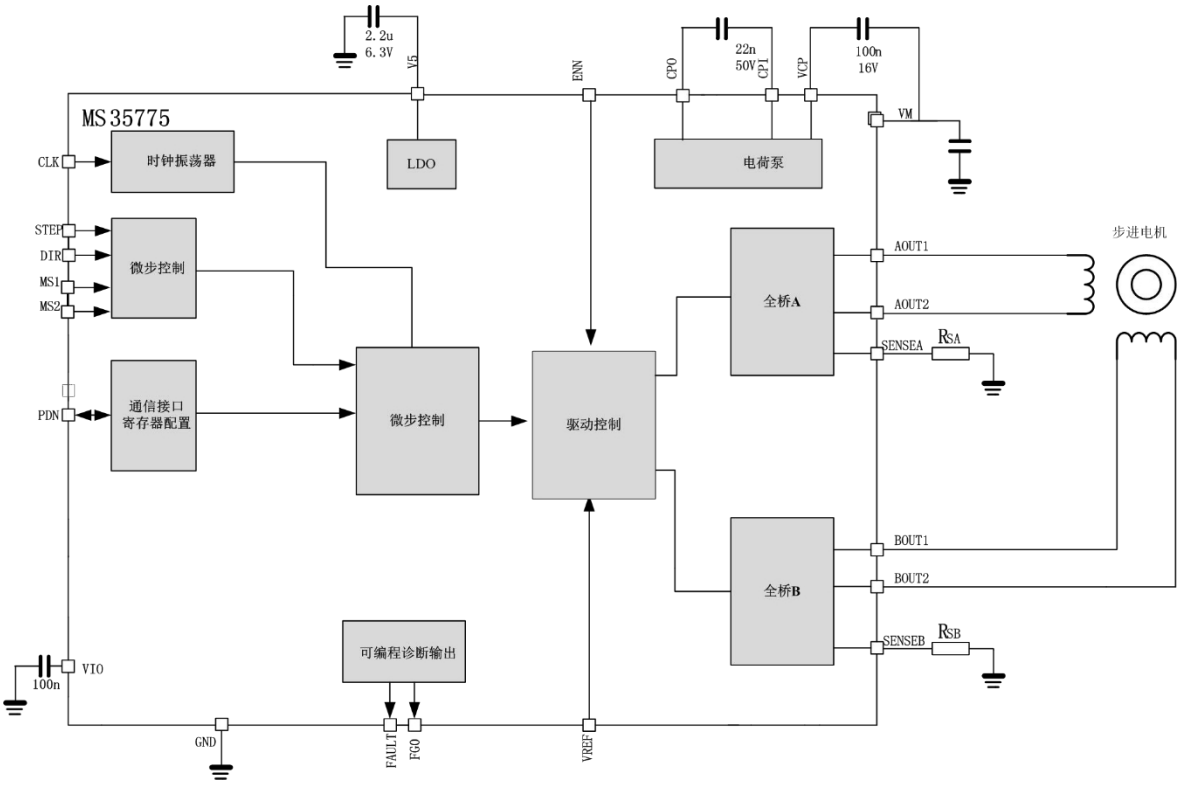
appliance

- Precision industrial equipment
- Medical equipment
- 3D printing
- control

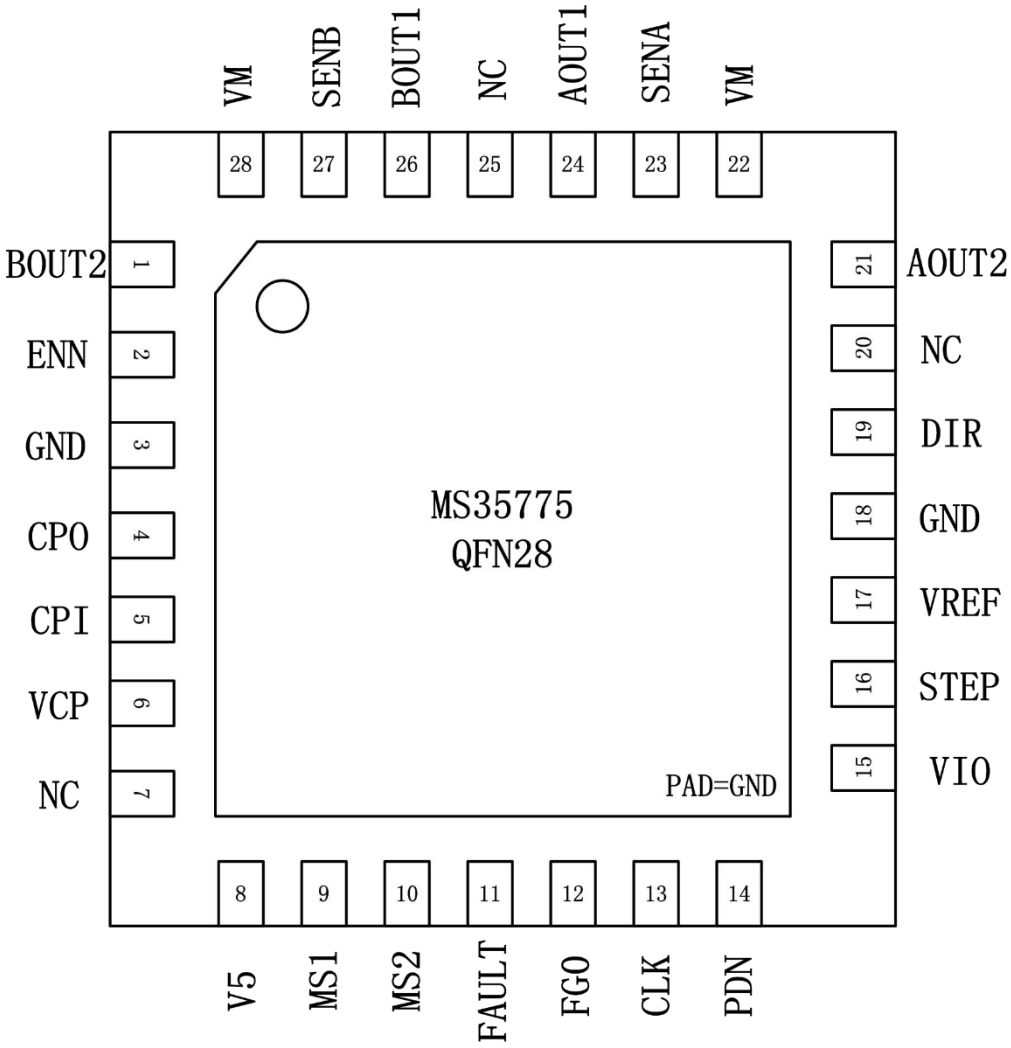
Product Specification Classification

offerings	Package form	Screen Printing Name
MS35775	QFN28	MS35775

Internal Block Diagram



Pin Arrangement



Pin Description

Pin Number	Pin Name	Pin Attributes	Pin Description
1	BOUT2	IO	Motor coil B output 2
2	ENN	DI	Enable input pin, turns off output when high
3	GND	GND	structural particle: used before a verb or adjective, linking it preceding the verb or adjective
4	CPO	IO	Charge Pump Capacitor Output
5	CPI	IO	Charge Pump Capacitor Input, 22nF (50V) Capacitor Connected to CPO
6	VCP	IO	Charge pump voltage with VM connected to 100nF capacitor
7	NC	NC	Pins not in use, can be suspended or grounded
8	V5	IO	Internal 5V LDO with 2.2uF to 4.7uF capacitor to ground
9	MS1	DI	Micro-step configuration port (built-in pull-down resistor)
10	MS2	DI	Micro-step configuration port (built-in pull-down resistor)
11	FAULT	DO	Internal error signal output. Output driver off when high. Can be reset to high with ENN setting.
12	FG0	DO	Provide A coil positive zero crossing pulse
13	CLK	DI	Clock input. Groundable when using the internal clock
14	PDN	DIO	Power off is not controlled by the input. (Automatic quiescent current attenuation mode at low level)
15	VIO		1.8V to 5V power supply for each digital input and output pin
16	STEP	DI	Microsteps Input Feet
17	VREF	AI	The analog reference voltage controls the current input pin or in the internal sense Analog reference current input in resistive mode
18	GND	GND	structural particle: used before a verb or adjective, linking it preceding the verb or adjective
19	DIR	DI	DIR input pin (built-in pull-down resistor)
20	NC	NC	Pins not in use, can be suspended or grounded
21	AOUT2	IO	Motor coil A output 2
22	VM	POWER	Motor supply voltage

23	SENA	IO	Coil A low side MOS source to sense resistor to ground. Internal sense resistor mode to ground.
24	AOUT1	IO	Motor coil A output 1
25	NC	NC	Pins not in use, can be suspended or grounded
26	BOUT1	IO	Motor coil B output 1
27	SENB	IO	Coil B low side MOS source to sense resistor to ground. Internal sense resistor mode to ground.
28	VM	POWER	Motor supply voltage

Limit parameters

Absolute maximum rating

parameters criticize (i.e. enumerate shortcomings)	notation	rating	unit (of measure)
Supply Voltage	VS	-0.5.... .39	V
IO supply voltage	VVIO	-0.5... .5.5	V
Digital supply voltage (using external power supply)	V5VOUT	-0.5... .5.5	V
Logic Input Voltage Range	VI	-0.5... .VIO+0.5	V
VREF Input Voltage (Do not exceed 10% of VIO and V5 at the same time, as this will enter the test mode) style)	VVREF	-0.5... .6	V
Maximum current for analog-digital ports	IIO	+/-10	mA

Scope of work

parameters criticize (i.e. enumerate shortcomings)	notation	Parameter range			unit (of measure)
		minimal	(an official) standard	greatest	
Supply voltage range (using internal V5)	VS	5.5	-	36	V
Supply voltage range (VS and V5 together)	VS	4.7	-	5.4	V
I/O supply voltage range	VVIO	1.8	-	5.25	V
RMS Current per Motor Coil	IRMS			1.2	A
One second on, one second off. RMS current.	IRMS			1.4	A
Peak current per motor coil	IOx			2	A
temperature of a bond	TJ	-40		125	℃

Electrical parameters

VM=24V

Note: Not specified, ambient temperature is Ta = 25°C ± 2°C. **Current Power Consumption:**

parameters criticize (i.e. enumerate shortcomings)	notation	Test Conditions	minimum value	typical value	maximum values	unit (of measure)
Current dissipation without load dilly-dally	IS	Fclk = 12MHz. no chopping		10	14	mA
Current dissipation without load dilly-dally	IS	Fclk = 12MHz, 35kHz chopping waviness		11		mA
V5 Supply current	IVCC	Fclk = 12MHz, 35kHz chopping waviness		10		mA
IO Supply Current	IVIO	IO without any load		30		uA

Digital inputs and outputs:

parameters criticize (i.e. enumerate shortcomings)	notation	Test Conditions	minimum value	typical value	maximum values	unit (of measure)
Input low potential	VINLO		-0.3		0.3Vio	V
Input high potential	VINHI		0.7Vio		Vio+0.3	V
Input SMIT hysteresis	VINHYST			0.12Vio		V
Output high potential	VOUTLO	I=2mA	Vio-0.2			V
Output low potential	VOUTHI	I=2mA			0.2	V

Motor Drive:

parameters criticize (i.e. enumerate shortcomings)	notation	Test Conditions	minimum value	typical value	maximum values	unit (of measure)
Down Resistors Low end rdson	RONL	I=100mA		0.28	0.38	Ω
Digital Port Capacitance	C			8		pF
High-end rdson	RONH	I=100mA		0.29	0.39	Ω
rising time	tSLPON	I=700mA	40	80	160	ns
descent time	tSLPOFF	I=700mA	40	80	160	ns
Source current	IOIDLE					

Charge pump:

parameters criticize (i.e. enumerate shortcomings)	notation	Test Conditions	minimum value	typical value	maximum values	unit (of measure)
Charge_pump Output	VVCP-VS	Operates at fchop < 40kHz	4	Vcc-0.3	VCC	V

5V LDO:

parameters criticize (i.e. enumerate shortcomings)	notation	Test Conditions	minimum value	typical value	maximum values	unit (of measure)
output voltage	V5	I5v=0mA	4.8	5	5.2	V
output resistance	RV5	static load		1		Ω
Deviation within the whole	V5T (DEV)	I=5mA, full operating temperature range		±90	±200	mV

Clock oscillator:

parameters criticize (i.e. enumerate shortcomings)	notation	Test Conditions	minimum value	typical value	maximum values	unit (of measure)
Clock frequency (factory setting)	fCLKOSC	T=50°C		11.7		MHz
	fCLKOSC	T=25°C	11.5	12.0	12.5	MHz
	fCLKOSC	T=150°C		12.1		MHz
applied clock frequency	fCLK		4	10-16	18	MHz

Detecting signals:

parameters criticize (i.e. enumerate shortcomings)	notation	Test Conditions	minimum value	typical value	maximum values	unit (of measure)
External clock timeout protection	VUV_VS Xtimeout	Supply Voltage Rise	3.5 32	4.3	4.6 48	V Fclk cycle
V5 Undervoltage protection detection	VUV_V5	5V LDO Voltage Rise		4.2		V
Upper tube overcurrent protection voltage	VOS2G		2	2.5	3	V
Lower tube overcurrent protection voltage	VOS2VS		1.6	2	2.3	V
Upper and lower tube short circuit protection detection time	tS2G	High end output level to VSP-3V	0.8	1	2	us
overtemperature warning	tOTPW	rise of temperature	100	120	140	℃
Over-temperature	tOT143	rise of temperature	128	143	159	℃

Sense resistor voltage:

parameters criticize (i.e. enumerate shortcomings)	notation	Test Conditions	minimum value	typical value	maximum values	unit (of measure)
Sense Voltage Peak Voltage (Low Sensitivity) (degrees)	VSRTL			300		mV
Sense Voltage Peak Voltage (High Sensitivity) (degrees)	VSRTH			165		mV
Internal Brx to external sense internal resistance between	Rxy			30		mΩ

Functional Description

The MS35775 is a two-phase stepper motor driver that utilizes a full-bridge output structure consisting of dual NDMOS to provide high current drive capability.

ENN controls the output driver, turning it on when ENN is low.

The MS35775 peripheral control is simple and its quiet nature is

particularly suitable for home or office use. **Microstep control**

The microstep steps are controlled by MS1 and MS2 as shown in the table below. a 160kΩ pull-down resistor is built into the MSx.

MS2	MS1	step by step
0	0	1/8
0	1	1/2
1	0	1/4
1	1	1/16

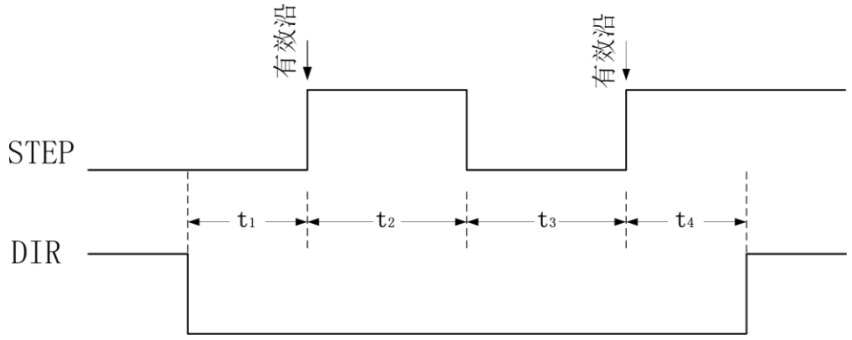
STEP Input

Each STEP can be a full step and a microstep. A full step can be equal to 2,4,8,16,32,64,128,256 microsteps. The internal tables are converted to sine and cosine values to control the motor current.

The MS35775 also incorporates an internal STEP pulse generator for applications that do not require precise position but only precise time and speed.

Direction control DIR

The direction of motor operation can be controlled by the DIR pin. The following diagram shows the timing of the STEP and DIR controls.



parameters	notation	prerequisite	minimal	typical case	greatest	unit (of measure)
STEP Frequency	fSTEP				1/2 fCLK	
full step frequency	fFS				fCLK/512	
DIR to STEP setup time	t1		20			ns
STEP Minimum High Level	t2			100		ns

Time						
STEP Minimum Low Level Time	t3			100		ns
DIR to STEP hold time	t4		20			ns
STEP and DIR Burr Filter Time	t5	Rising or falling edge	13	20	30	ns

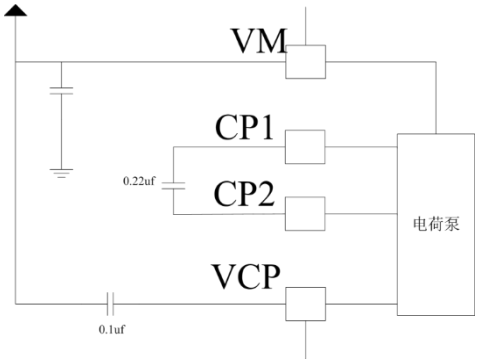
5V Regulated Power Supply

The MS35775 also provides a 5V regulated power output, which requires a capacitor between 2.2uF and 4.7uF. There is an internal structure to detect the V5 voltage, and all output tubes will shut down if there is an abnormality (low voltage).

charge pump

Since the output stage utilizes an N-channel FET, a gate voltage higher than the supply voltage is required to drive the tube fully open. The MS35775 has an internal charge pump circuit to generate this high voltage.

For normal operation, the charge pump circuit requires two external capacitors, as shown below:



current control

The peak current of motor operation is determined by the combination of the $R_{SENSE\ resistance}$ and the input voltage at the VREF pin.
The formula for calculating the peak current is as follows:

$$I_{RMS} = \frac{300mV}{RSENSE} * \frac{VVREF}{2.5V}$$

The corresponding RMS current is calculated as follows:

$$I_{RMS} = \frac{300mV}{RSENSE} * \frac{1}{\sqrt{2}} * \frac{VVREF}{2.5V}$$

Automatic current attenuation

The automatic current attenuation feature is enabled by pulling down the PDN pin, which reduces power consumption to 33% when running at about 50% current.

Over Zero Output Flag

The MS35775 provides the over-zero output flag bit FG0, which outputs a pulse signal when the motor coil current is positively over-zero. **Error Output Flag**

When an internal error signal occurs, a diagnostic signal is output through the error indication pin FAULT pin.

The ENN pin is reset and FAULT is low during normal operation.

Protection Circuit

The MS35775 features over-current protection, under-voltage protection, and over-temperature

protection.

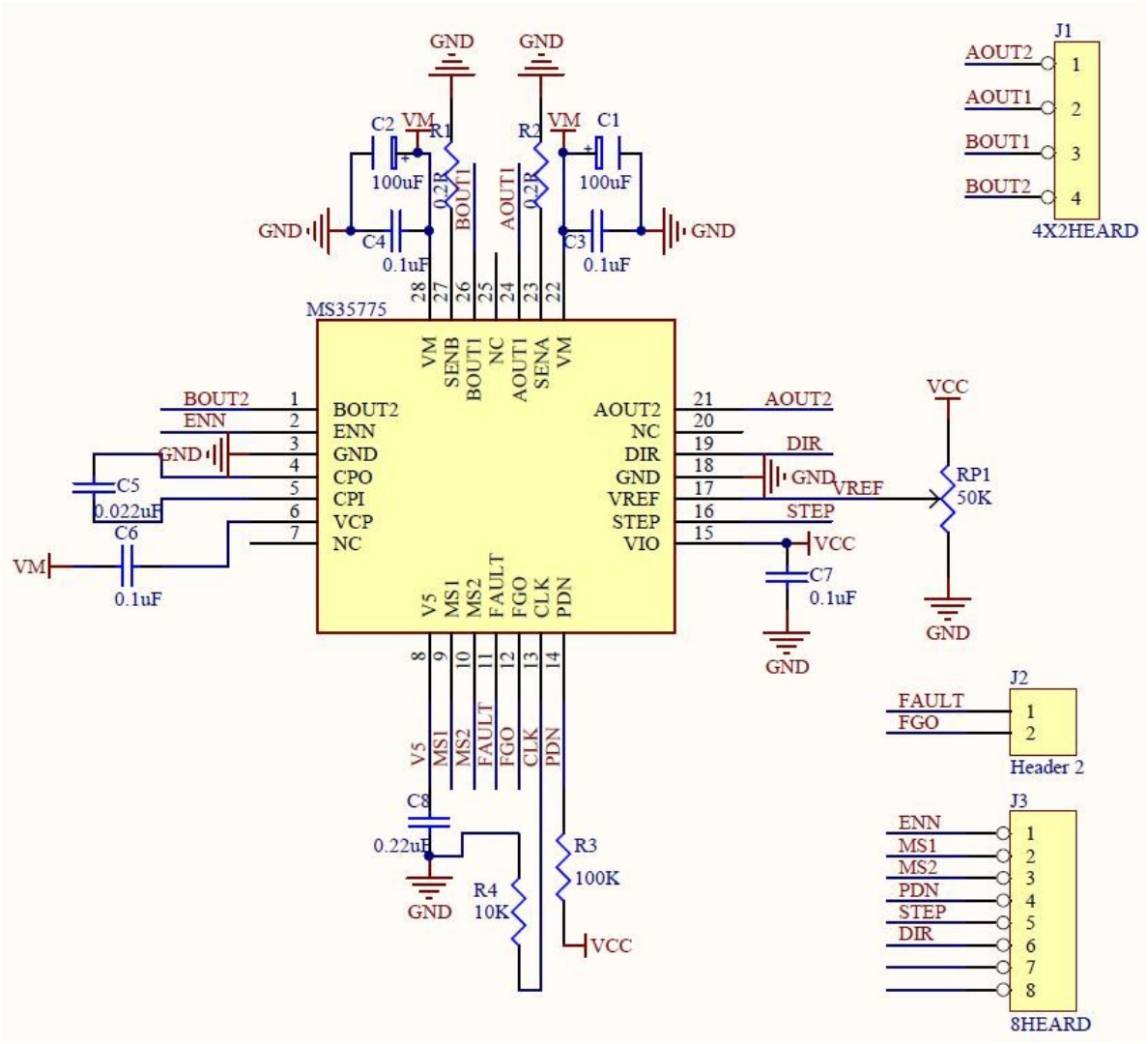
When the motor loads are shorted together or directly grounded, the chip will protect itself by detecting the overcurrent and shutting down the shorted driver tubes, stopping damage to the internal devices, and FAULT outputs a high signal that requires the ENN pin to be reset.

When the temperature of the chip exceeds the set threshold, the over-temperature protection circuit will function and all channels will be shut down and FAULT output.

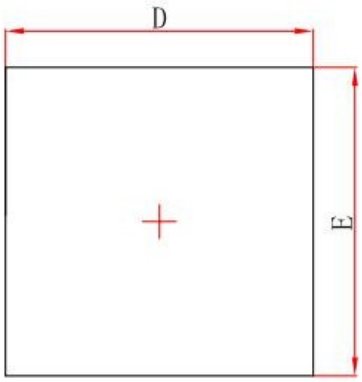
A high signal. When the temperature falls back to a safe temperature, the chip will return to normal operation.

When the chip's supply voltage drops below the undervoltage protection threshold, the chip shuts down all channels and resets the internal logic circuits. When the voltage returns above the threshold, the chip returns to normal operation.

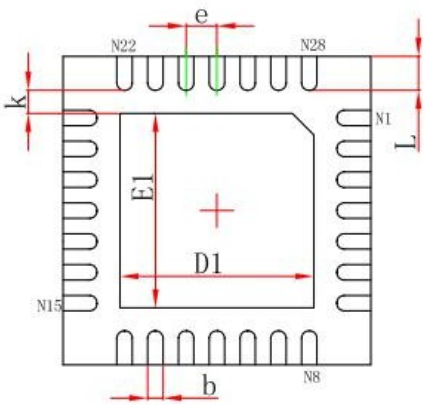
Typical Application Diagram



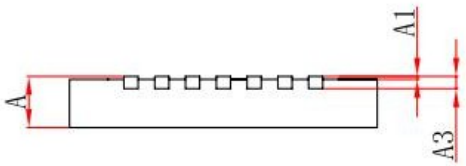
Package Outline Diagram



Top View



Bottom View



Side View

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	4.900	5.100	0.193	0.201
E	4.900	5.100	0.193	0.201
D1	3.050	3.250	0.120	0.128
E1	3.050	3.250	0.120	0.128
k	0.200MIN.		0.008MIN.	
b	0.180	0.300	0.007	0.012
e	0.500 TYP.		0.020TYP.	
L	0.450	0.650	0.018	0.026

Seal and Packaging Code

I. Introduction to the content of the seal

Model No: MS35775

Production lot number: XXXXXXXX

II. Requirements for the specification of seals

It is laser printed, centered and in Arial font.

III. Packaging instructions:

model number	Package form	only/roll	Rolls/box	Only/box	Box/Carton	Only/box
MS35775	QFN28	1000	8	8000	4	32000

Precautions for MOS circuit operation:

Static electricity is generated in many places. Taking the following precautions can effectively prevent damage to MOS circuits due to the effects of electrostatic discharge:

1. The operator should be grounded through an anti-static wrist strap.
2. The equipment enclosure must be grounded.
3. Tools used in the assembly process must be grounded.
4. It must be packed or transported in conductor packaging or antistatic materials.

+86-571-89966911

No.1 Weiye Road,
Binjiang District,
Hangzhou, China

http:// www.relmon.com

Room 701, Building 9, Hi-Tech Software Park