Reversible Motor Drivers for Brush Motors

0.5A or Less Reversible Motor Drivers (Single Moter)

BH6578FVM,BD7931F

No.11008EBT05

● Description

The BH6578FVM and BD7931F are reversible motor drivers with a wide output dynamic range, with power MOS used for the output transistor. The motor drivers can set the output mode to four modes of normal rotation, reverse rotation, stop (idling), and braking in accordance with input logic (2 inputs).

● Features

1) Wide dynamic range loading driver with MOS output, Ron = 1.0Ω (Top+Bottom)
2) With loading driver voltage setting terminal
3) Built-in thermal shutdown circuit (TSD)
4) MSOP8 package (BH6578FVM)
5) SOP8 package (BD7931F)

● Applications

Tray loading of CD/DVD, applications using DC motors

● Absolute maximum ratings (Ta=25℃)

Parameter	Symbol	Ratings		Unit
		BH6578FVM	BD7931F	
Supply Voltage	Vcc	7	15	V
Power dissipation	Pd	0.55 *	0.69**	W
Operating temperature	Topr	-35～+85	-40～85	℃
Storage temperature	Tstg	-55～+150		℃
Output current	Iout	500		mA
Junction temperature	Tjmax	150		℃

* When 70 mmx70 mmx1.6 mm thick glass epoxy substrate with less than 3% copper foil occupancy ratio is mounted.
When used at Ta=25°C or higher, derated at 4.4 mW/°C.
** When 70 mmx70 mmx1.6 mm thick glass epoxy substrate with less than 3% copper foil occupancy ratio is mounted.
When used at Ta=25°C or higher, derated at 5.5 mW/°C.

● Recommended operating range

Parameter	Symbol	Range		Unit
		BH6578FVM	BD7931F	
Supply voltage	Vcc	4.5~5.5	4.5～14	V

● Truth table

BH6578FVM,BD7931F

INPUT		OUTPUT		Function
INFWD	INREV	OUT+	OUT-	
L	L	Hi Z	Hi Z	High Impedance
L	H	L	H	REV mode
H	L	H	L	FWD mode
H	H	L	L	Brake mode

Hiz：Hi-impedance

●Electrical characteristics

BH6578FVM(Unless otherwise specified, Ta=25℃, Vcc=5V)

Parameter	Symbol	Limits.			Unit	Conditions
		Min.	Typ.	Max.		
Standby current	ICC1	-	0.4	0.8	mA	No load
(Loading Driver)						
Output offset voltage	VOFSL	-15	0	+15	mV	Brake mode
Input threshold voltage H	VIH	2.0	—	Vcc	V	
Input threshold voltage L	VIL	GND	—	0.5	V	
ON resistance	RON	—	1.0	1.8	Ω	Io=500mA,Top+Bottom
Voltage gain (Loading)	GVLD	4.5	6.0	7.5	dB	*1
Voltage gain difference (Loading)	ΔGVLD	-2.0	0	2.0	dB	
Input bias current	IINL	—	86	120	µA	FIN=5V,RIN=5V
LDCONT bias current	ILDC	—	—	300	nA	CONT=2V

* No radiation-resistant design is adopted for the present product.

*1. Let V01 denote output-to-output voltage when CONT=1V and V02 denote output-to-output voltage when CONT=3.5V, voltage gain can be expressed by the following equation:$GVLD=20\log|(V02-V01)/2.5|$

BD7931F(Unless otherwise specified, Ta=25℃, Vcc=8V)

Parameter	Symbol	Limits.			Unit	Conditions
		Min.	Typ.	Max.		
Standby current	ICC1	-	0	5	µA	
Supply current 1	ICC2	-	1.1	2.2	mA	FIN=5V,RIN=0V
Supply current 2	ICC3	-	0.8	1.6	mA	FIN=RIN=5V
(Loading Driver)						
Output offset voltage	VOFSL	-35	0	+35	mV	Brake mode
Input threshold voltage H	VIH	2.0	—	Vcc	V	
Input threshold voltage L	VIL	GND	—	0.5	V	
ON resistance	RON	—	1.0	1.8	Ω	Io=500mA,Top+Bottom
Voltage gain (Loading)	GVLD	4.0	6.0	8.0	dB	*2
Voltage gain difference (Loading)	ΔGVLD	-2.0	0	2.0	dB	
Input bias current	IINL	—	165	250	µA	FIN=5V,RIN=5V
LDCONT bias current	ILDC	—	—	300	nA	CONT=5V

* No radiation-resistant design is adopted for the present product.

*1. Let V01 denote output-to-output voltage when CONT=1V and V02 denote output-to-output voltage when CONT=3.5V, voltage gain can be expressed by the following equation:$GVLD=20\log|(V02-V01)/2.5|$
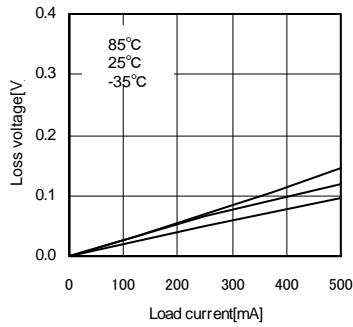
●Reference data

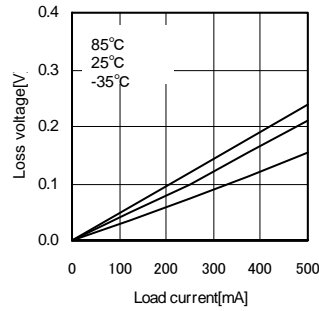Fig.1 Output loss voltage L(BH6578FVM)
Vcc=5V, CONT=OPEN
FWD mode

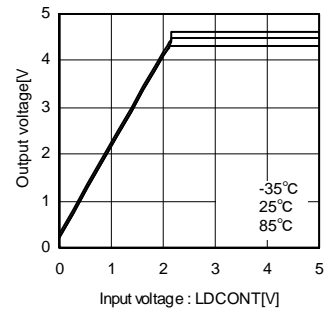Fig.2 Output loss voltage L(BH6578FVM)
Vcc=5V, CONT=OPEN
REV mode

Fig.3 Voltage gain(BH6578FVM)
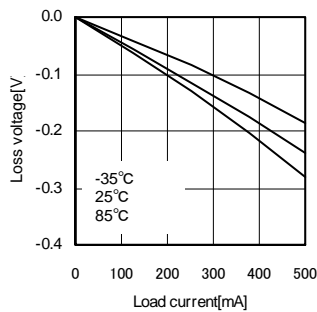Vcc=5V, CONT=SWEEP
RL=8Ω+47μH

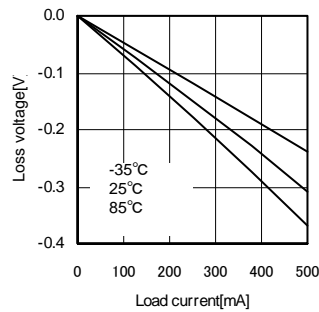Fig.4 Output loss voltage H(BH6578FVM)
Vcc=5V, CONT=OPEN
FWD mode

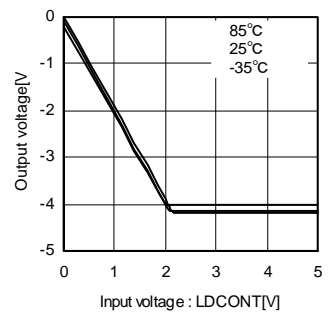Fig.5 Output loss voltage H(BH6578FVM)
Vcc=5V, CONT=OPEN
REV mode

Fig.6 Voltage gain (BH6578FVM)
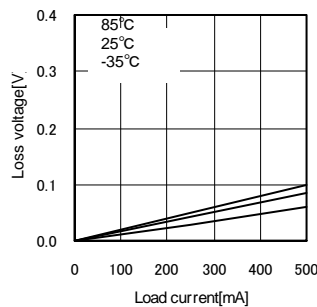Vcc=5V, CONT=SWEEP
RL=8Ω+47μH

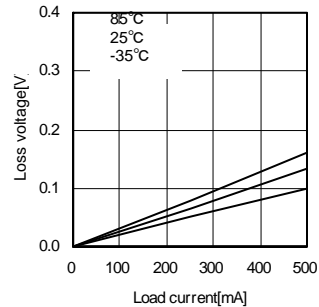Fig.7 Output loss voltage L(BD7931F)
Vcc=8V, CONT=OPEN
FWD mode

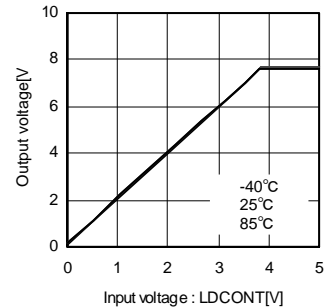Fig.8 Output loss voltage L(BD7931F)
Vcc=8V, CONT=OPEN
REV mode

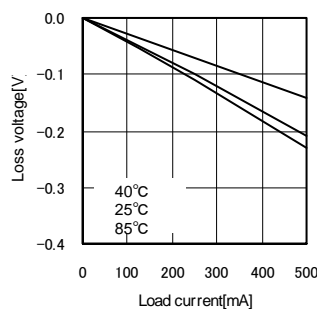Fig.9 Voltage gain (BD7931F)
Vcc=8V, CONT=SWEEP
RL=20Ω+47μH

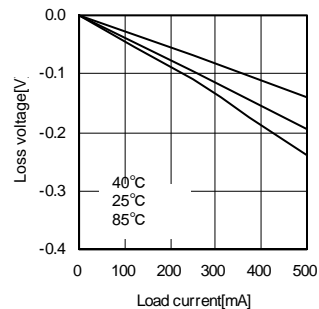Fig.10 Output loss voltage H(BD7931F)
Vcc=8V, CONT=OPEN
FWD mode

Fig.11 Output loss voltage H(BD7931F)
Vcc=8V, CONT=OPEN
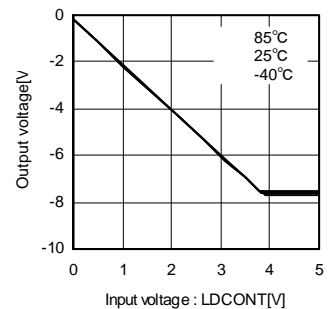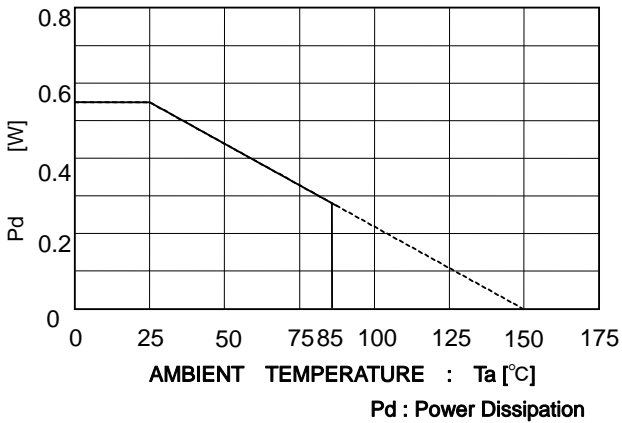REV mode

Fig.12 Voltage gain(BD7931F)
Vcc=8V, CONT=SWEEP
RL=20Ω+47μH

●Thermal derating curves

BH6578FVM

BD7931F
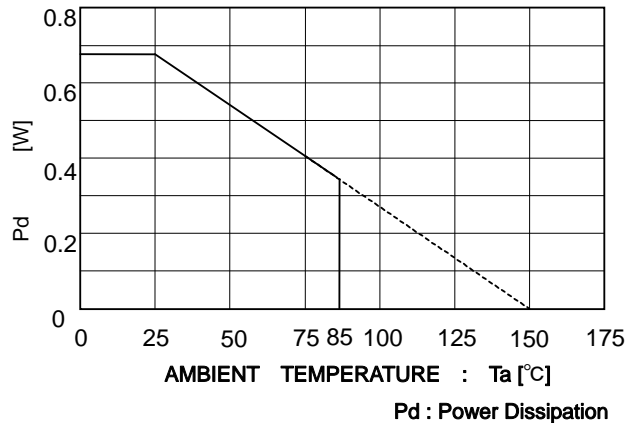
Pd : Power Dissipation

Pd : Power Dissipation

*when 70 mmx70 mmx1.6 mm thick glass epoxy substrate with less than 3% copper foil occupancy ratio is mounted.

●Block diagram, applied circuit diagram example

BH6578FVM, BD7931F (in common)
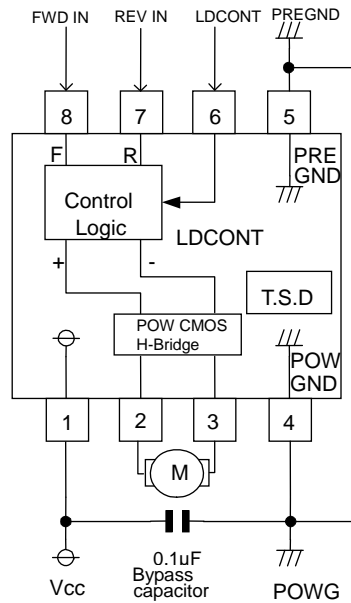
T.S.D: Thermal shutdown

Fig.13

●Pin descriptions

Pin No.	Pin Name	Function	Pin No.	PinName	Function
1	Vcc	Supply voltage	5	GND_S	Signal ground
2	OUT+	FWD output	6	LDCONT	Loading driver voltage setting pin
3	OUT-	REV output	7	INREV	REV input
4	GND	Power ground	8	INFWD	FWD input

● Interfaces

BH6578FVM
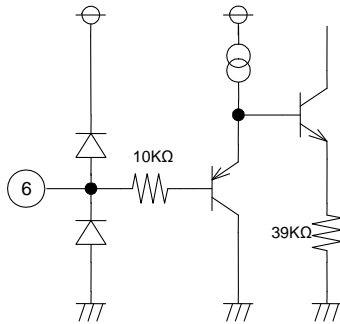
BD7931F

LDCONT

LDCONT

Fig.14
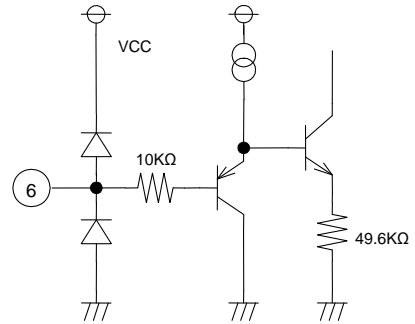
Fig.17
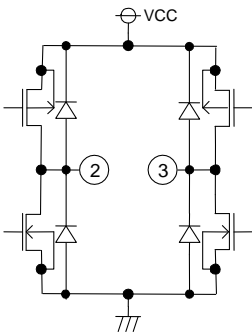
OUT+/OUT-

INFWD/INREV

OUT+/OUT-

FIN/RIN

Fig.15
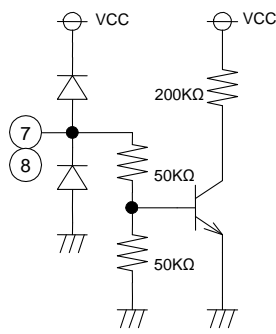
Fig.16
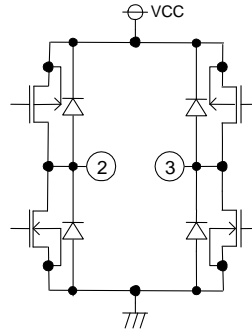
Fig.18
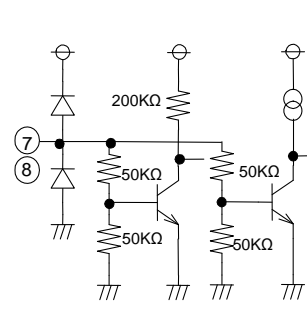
Fig.19

● Operations

(1) CONTROL LOGIC

Operation of each mode is carried out as follows:

When INFWD is "H" and INREV is "L," the normal rotation mode is achieved and current flows from OUT$^+$ to OUT$^-$. When both INFWD and INREV are "H," the brake mode is achieved.   Operation in such event is described as follows: the top-side transistor turns OFF to stop supplying motor drive current, the bottom-side transistor turns ON to absorb reverse EMF of motor and applies brake to motor.   When both INFWD and INREV are "L," OUT$^+$ and OUT$^-$ potentials become open and the motor stops.

(2) LOADING CONT

Controlling the output voltage can vary voltage applied to the motor and can control the motor speed.   By the voltage entered to the CONT terminal, the output H voltage can be controlled (gain 6dB Typ.).   Even if the voltage entered is increased more than necessary (Vcc Max), the output voltage never exceeds the power supply voltage.

●Notes for use

(1) Absolute maximum ratings
In the event that applied voltage (VCC, VM), working temperature range (Topr), and other absolute maximum rating are exceeded, the IC may be destroyed.   Because it is unable to identify the short-circuit mode, open mode, etc., if any special mode is assumed, which exceeds the absolute maximum rating, physical safety measures are requested to be taken, such as fuses, etc.

(2) Reverse connection of power supply connector
Reverse connection of power supply connector may destroy the IC.   Take necessary measures to protect the IC from reverse connection breakage such as externally inserting diodes across power supply and IC power supply terminal as well as across power supply and motor coil.

(3) Power supply line
Because return of current regenerated by reverse EMF of a motor occurs, take necessary measures such as inserting capacitors across the power supply and GND as a path for regenerated current, and determine the capacity value after thoroughly confirming that there would be no problems in various characteristics such as capacitance drop at low temperature which may occur with electrolytic capacitors.

(4) Ground potential
Keep the GND terminal potential to the minimum potential under any operating condition.   In addition, check if there is actually any terminal which provides voltage below GND including transient phenomena.

(5) Thermal design
Consider permissible dissipation (Pd) under actual working condition and carry out thermal design with sufficient margin provided.

(6) Terminal-to-terminal short-circuit and erroneous mounting
When the present IC is mounted to a printed circuit board, take utmost care to direction of IC and displacement.   In the event that the IC is mounted erroneously, IC may be destroyed.   In the event of short-circuit caused by foreign matter that enters in a clearance between outputs or output and power-GND, the IC may be destroyed.

(7) Operation in strong electromagnetic field
The use of the present IC in the strong electromagnetic field may result in maloperation, to which care must be taken.

(8) ASO
When IC is used, design in such a manner that the output transistor to a motor does not exceed absolute maximum ratings and ASO.

(9) Thermal shutdown circuit (TSD) (common)
When junction temperature (Tj) becomes thermal shutdown ON temperature 175°C, the thermal shutdown circuit (TSD circuit) is activated and driver output current is shorted.   There is 25°C temperature hysteresis.   The thermal shutdown protection circuit is first and foremost intended for interrupt IC from thermal runaway, and is not intended to protect and warrant the IC.   Consequently, never attempt to continuously use the IC after this circuit is activated or to use the circuit with the activation of the circuit premised.

(10) Capacitor across output and GND
In the event a large capacitor is connected across output and GND, when Vcc and VIN are short-circuited with 0V or GND for some kind of reasons, current charged in the capacitor flows into the output and may destroy the IC.   Use a capacitor smaller than 0.1 μF between output and GND.

(11) Inspection by set substrate
In the event a capacitor is connected to a pin with low impedance at the time of inspection with a set substrate, there is a fear of applying stress to the IC.   Therefore, be sure to discharge electricity for every process.   Furthermore, when the set substrate is connected to a jig in the inspection process, be sure to turn OFF power supply to connect the jig and be sure to turn OFF power supply to remove the jig.   As electrostatic measures, provide grounding in the assembly process, and take utmost care in transportation and storage.

(12) IC terminal input

The present IC is a monolithic IC and has P^+ isolation and a P substrate between elements to separate elements. With this P layer and N layer of each element, PN junction is formed, and various parasitic elements are formed. For example, when resistors and transistors are connected to terminals as is the case of Fig.20, where in the case of resistor, the potential difference satisfies the relation of ground (GND)>(terminal A), and in the case of transistor (NPN), the potential difference satisfies the relation of ground (GND)>(terminal B), PN junction works as a diode.

Furthermore, in the case of transistor (NPN), a parasitic NPN transistor operates by the N-layer of other elements adjacent to the parasitic diode. The parasitic element is inevitably formed because of the IC construction. The operation of the parasitic element gives rise to mutual interference between circuits and results in malfunction, and eventually, breakdown. Consequently, take utmost care not to use the IC to operate the parasitic element such as applying voltage lower than GND (P substrate) to the input terminal.

In addition, when the power supply voltage is not applied to IC, do not apply voltage to the input terminal, either. Similarly, when the power supply voltage is applied, each input terminals shall be the voltage below the power supply voltage or within the guaranteed values of electrical properties.
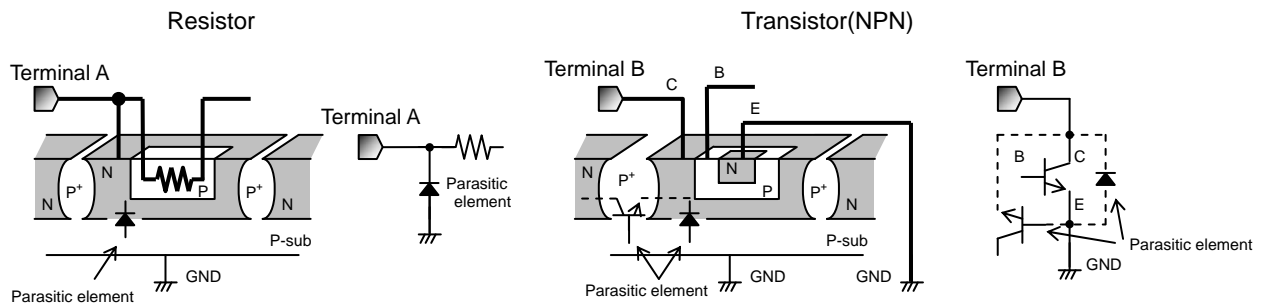
Fig.20   Example of the basic structure of a bipolar IC

(13) GND wiring pattern

If there are a small signal GND and a high current GND, it is recommended to separate the patterns for the high current GND and the small signal GND and provide a proper grounding to the reference point of the set not to affect the voltage at the small signal GND with the change in voltage due to resistance component of pattern wiring and high current. Also for GND wiring pattern of the component externally connected, pay special attention not to cause undesirable change to it.

●Operating part numer

| B | H | | 6 | 5 | 7 | 8 | | F | V | M | - | T | R |

Part No
BH
BD

Part No
6578
7931

Package
FVM : MSOP8
F : SOP8

Packaging and forming specification
E2: Embossed tape and reel
    (SOP8)
TR: Embossed tape and reel
    (MSOP8)

MSOP8

2.9±0.1
(MAX 3.25 include BURR)

4.0±0.2
2.8±0.1

8 7 6 5

1 2 3 4

1PIN MARK

0.475

4°$^{+6°}_{-4°}$

0.29±0.15
0.6±0.2

0.145 $^{+0.05}_{-0.03}$

S

0.9MAX

0.75±0.05
0.08±0.05

0.22 $^{+0.05}_{-0.04}$

0.08 S

0.65

(Unit : mm)

<Tape and Reel information>

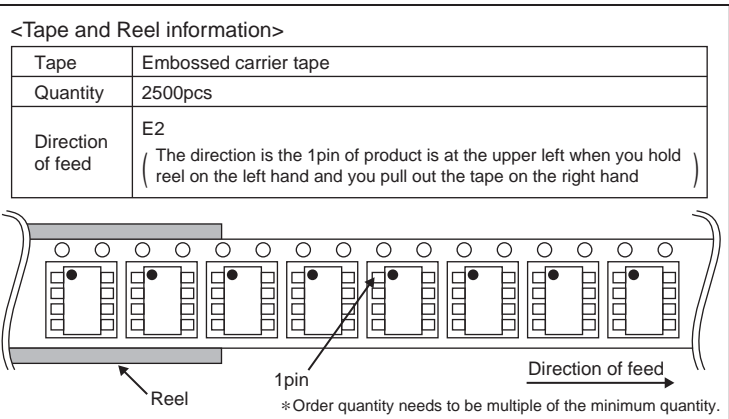| Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	TR (The direction is the 1pin of product is at the upper right when you hold reel on the left hand and you pull out the tape on the right hand)

1pin

Direction of feed

Reel

＊Order quantity needs to be multiple of the minimum quantity.

SOP8

5.0±0.2
(MAX 5.35 include BURR)

6.2±0.3
4.4±0.2

8 7 6 5

2 3 4

0.595

4°$^{+6°}_{-4°}$

0.3MIN
0.9±0.15

0.17 $^{+0.1}_{-0.05}$

S

1.5±0.1
0.11

0.1 S

1.27

0.42±0.1

(Unit : mm)

<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)

1pin

Direction of feed

Reel

＊Order quantity needs to be multiple of the minimum quantity.

Notes

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