

## 8 BIT SERIAL IN/PARALLEL OUT DRIVER

The  $\mu$ PD6345 is a monolithic Bi-CMOS integrated Circuit designed to drive LED, Solenoid and Relay.

This device consists of an 8-bit shift register, latch and buffer with high voltage N-P-N Transistors (Open Collector). Data is serially loaded into shift register on the positive-going transition of the clock. Parallel data is transferred to the output buffers through the 8-bit latch while the latch enable input is high and latched when the latch enable is low. When the output enable input is low, all outputs are off (High Impedance).

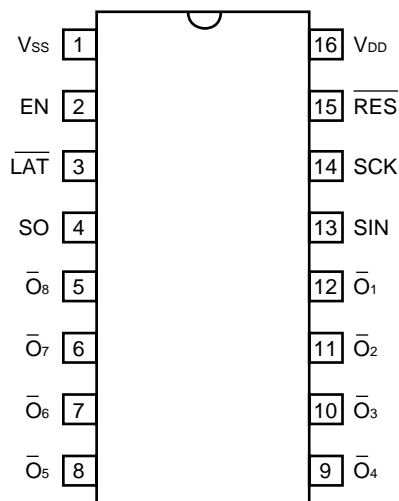
### FEATURES

- High Speed Serially-shifted Data Input.
- Latches on all driver Outputs.
- 40 V Output Voltage Rating.
- 60 mA Output Sink Current.
- Built in power supply voltage detection circuit.
- Capable of connection to cascade additional device.
- Wide Operating Temperature Range:  $-40$  to  $+85$  °C
- Bi-CMOS STRUCTURE

### ORDERING INFORMATION

Part Number	Package
$\mu$ PD6345C	16 Pin Plastic DIP (300 mil)
$\mu$ PD6345GS	16 Pin Plastic SOP (300 mil)

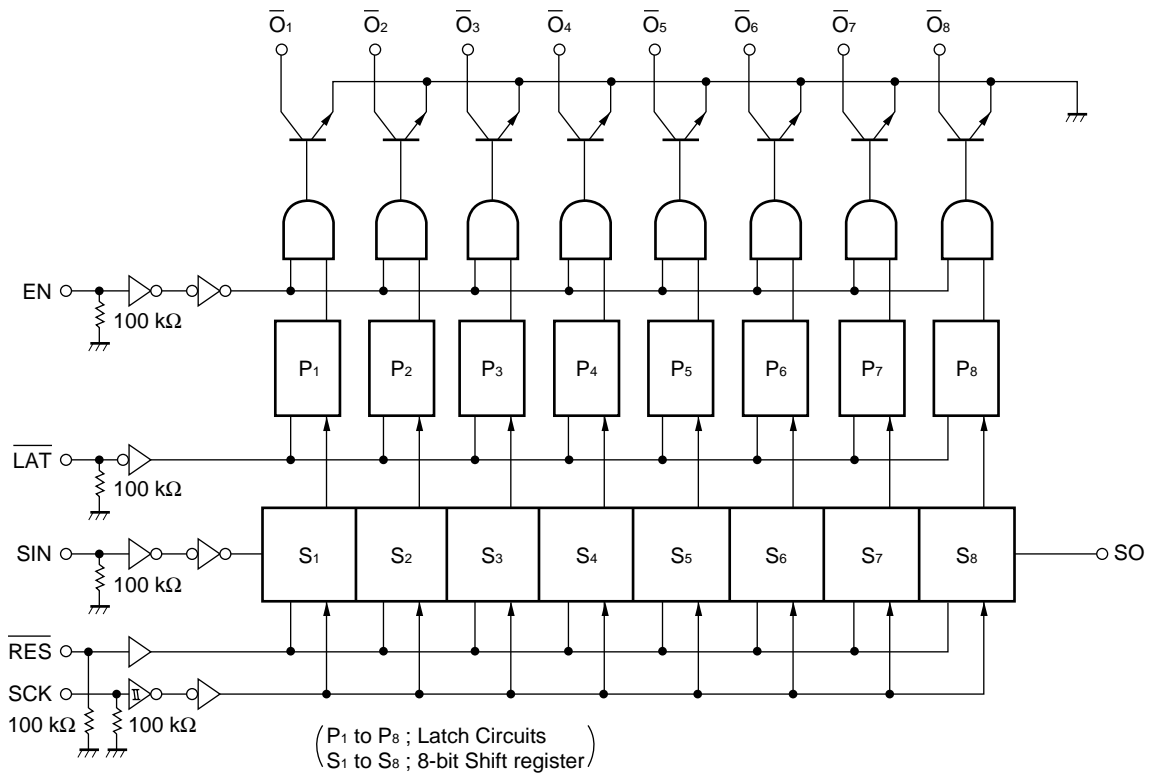
**PIN CONFIGURATION (Top View)**



**PIN IDENTIFICATION**

Pin No.	Symbol	Pin name	Input/Output	Function
1	GND	Ground	—	Connection to Ground (GND) of system.
2	EN	Output Enable	Input	When this pin is low or open, all outputs are OFF, and data is output during high.
3	LAT	Latch Enable	Input	When this pin is low or open, data is latched and data is through to output during high.
4	SO	Serial data Output	Output	Serial data is output on positive-going transition of the clock. In case of connection to cascade additional device (μPD6345), this pin will be connected to SIN terminal of additional device.
5 to 12	O <sub>8</sub> to O <sub>1</sub>	Driver Output	Output	High Voltage and Current Driver Outputs.
13	SIN	Serial data Input	Input	Data is loaded to shift register on positive-going transition.
14	SCK	Clock	Input	Data of SIN is loaded to shift register on positive-going transition of SCK. Also, serial data is output from SO on positive-going transition of SCK.
15	RES	Reset	Input	When this pin is low or open, data of shift register is all cleared, and this device operate normally during high.
16	V <sub>DD</sub>	Power Supply	—	Normally supply 5 V.

**BLOCK DIAGRAM**



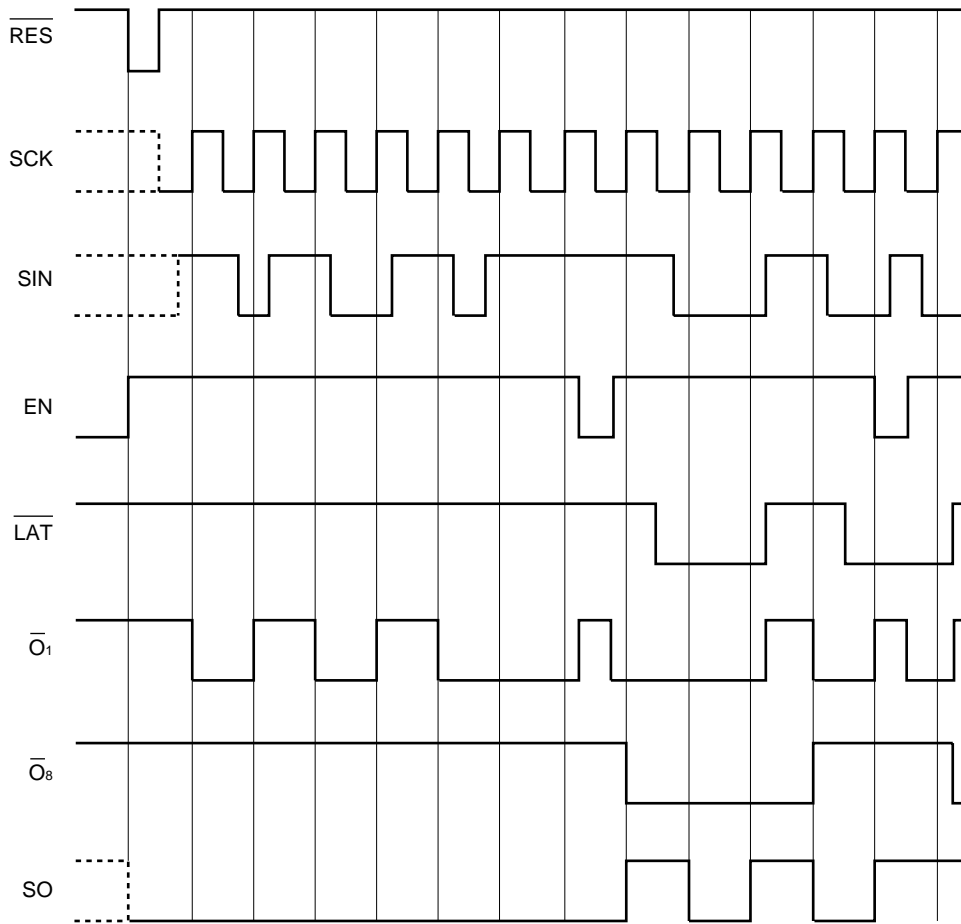
**TRUTH TABLE**

SCK	EN	$\overline{RES}$	$\overline{LAT}$	SIN	OUT		SO*1	Note
					$\overline{O_1}$	$\overline{O_n}$		
	H	H	H	L	High Impedance	$\overline{O_{n-1}}$	S <sub>7</sub>	SCK = CLOCK EN = Output Enable $\overline{RES}$ = Reset $\overline{LAT}$ = Latch Enable SIN = Serial data Input OUT = Driver Output SO = Serial data Output * = H or L H = High level L = Low level
	H	H	H	H	L	$\overline{O_{n-1}}$	S <sub>7</sub>	
	H	H	L*2	*	NO CHANGE	NO CHANGE	S <sub>7</sub>	
	L	H	*	*	High Impedance	High Impedance	S <sub>7</sub>	
	*	*	*	*	NO CHANGE	NO CHANGE	S <sub>8</sub>	
*	*	L	H	*	High Impedance	High Impedance	L	
*	H		L	*	NO CHANGE	NO CHANGE	L	

\*1) Seventh data S<sub>7</sub> of shift register is loaded to eighth data S<sub>8</sub> on positive-going transition of clock, and is output to Serial data Output pin.

\*2) Shift register operates normally.

TIMING CHART



**ABSOLUTE MAXIMUM RATINGS (T<sub>a</sub> = 25 °C ± 2 °C)**

Supply Voltage	V <sub>DD</sub>	-0.3 to 7.0	V
Input Voltage	V <sub>IN</sub>	-0.3 to V <sub>DD</sub> + 0.3	V
Input Current	V <sub>IN</sub>	±10	mA
Logic Output Voltage	V <sub>SO1</sub>	-0.3 to V <sub>DD</sub> + 0.3	V
Driver Output Voltage	V <sub>OUT2</sub>	-0.3 to 40	V
Driver Output Current	I <sub>OUT</sub>	100	mA
Logic Output Current	I <sub>SO</sub>	+10 -5	mA
Power Dissipation	P <sub>D</sub>	850 (DIP), 800 (SOP)	mW
Operating Temperature	T <sub>opt</sub>	-40 to + 85	°C
Storage Temperature	T <sub>stg</sub>	-55 to +150	°C

**RECOMMENDED OPERATING CONDITIONS**

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT
Operating Temperature	T <sub>opt</sub>	-40		+85	°C
Supply Voltage	V <sub>DD</sub>	4.0	5.0	6.0	V
Input Voltage	V <sub>IN</sub>	0		V <sub>DD</sub>	V
High Level Input Voltage	V <sub>IH</sub>	0.7 V <sub>DD</sub>		V <sub>DD</sub>	V
Low Level Input Voltage	V <sub>IL</sub>	0		0.2 V <sub>DD</sub>	V
Clock Frequency	f <sub>SCK</sub>			8	MHz
Driver Output Voltage	V <sub>OUT</sub>	0		38	V

**ELECTRICAL CHARACTERISTICS (RH ≤ 70 %, V<sub>SS</sub> = 0 V)**

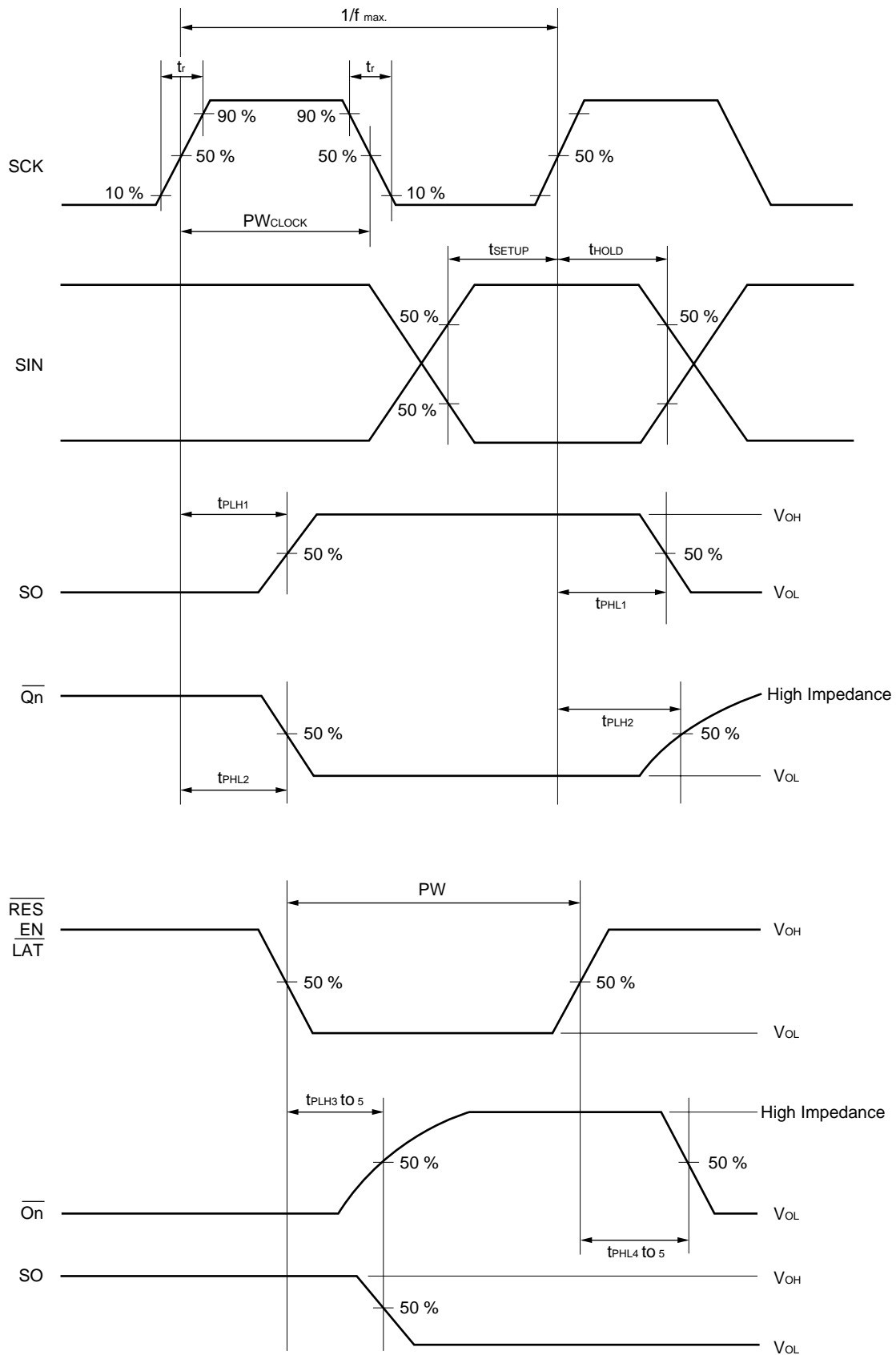
ITEM	SYMBOL	CONDITION		T <sub>a</sub> = 25 °C			T <sub>a</sub> = -40 to +85 °C			UNIT
		V <sub>DD</sub> (V)		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
High Level Input Voltage	V <sub>IH</sub>	5.0		3.5	2.4		3.5			V
		6.0		4.2			4.2			
Low Level Input Voltage	V <sub>IL</sub>	5.0			1.7	1.0			1.0	V
		6.0				1.2			1.2	
High Level Input Current	I <sub>IH</sub>	6.0	V <sub>IN</sub> = V <sub>DD</sub>		100	300			300	μA
Low Level Input Current	I <sub>IL</sub>	6.0	V <sub>IN</sub> = V <sub>SS</sub>		0.03	0.3			1	μA
High Level Output Voltage 1	V <sub>SOH1</sub>	5.0	I <sub>SOH</sub> = -250 μA	3.6			3.6			V
		6.0	I <sub>SOH</sub> = -300 μA	4.3			4.3			
High Level Output Voltage 2	V <sub>SOH2</sub>	5.0	I <sub>SOH</sub> = -10 μA	4.0			4.0			V
		6.0		5.0			5.0			
High Level Output Voltage 3	V <sub>SOH3</sub>	5.0	I <sub>SOH</sub> = -1 μA	3.3			3.3			V
		6.0		4.0			4.0			
Low Level Output Voltage	V <sub>SOL</sub>	5.0	I <sub>SOL</sub> = 8 μA						0.6	V
		6.0							0.5	
Low Level Output Voltage (Driver)	V <sub>OUT(L)</sub>	5.0	I <sub>OUT</sub> = 60 μA		0.45	0.8			1.0	V
High Level Output Leakage Current	I <sub>OHL</sub>	5.0				10			10	μA
Supply Current	I <sub>DD1</sub>	5.0	$\overline{O}_1 - \overline{O}_8$		0.25	0.5			1.0	mA
	I <sub>DD2</sub>	5.0			23	35			40	
Input Capacitance	C <sub>IN</sub>	—			6	15			15	pF

**SWITCHING CHARACTERISTICS**

( $T_a = 25\text{ }^\circ\text{C}$ ,  $V_{DD} = 5\text{ V}$ ,  $C_L = 15\text{ pF}$ ,  $R(\overline{O}_n) = 300\text{ }\Omega$ ,  $V_{OUT} = 12\text{ V}$ ,  $t_r = t_f = 6\text{ ns}$ )

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time	$t_{PLH1}$	SCK → SO (High Level)	20		100	ns
	$t_{PLH2}$	SCK → Driver Output (High Level)	20		1	μs
	$t_{PHL1}$	SCK → SO (Low Level)			100	ns
	$t_{PHL2}$	SCK → Driver Output (Low Level)			1	μs
	$t_{PHL3}$	RESET → SO			100	ns
	$t_{PHL/PLH4}$	Output Enable → Driver Output			1	μs
	$t_{PHL/PLH5}$	Latch Enable → Driver Output			1	μs
Clock Transition Time	$t_r$ $t_f$	SCK		70		μs
Maximum Clock Frequency	$f_{max}$			13	8	MHz
Minimum Data Setup Time	$t_{SETUP}$		20	10		ns
Minimum Data Hold Time	$t_{HOLD}$		20	10		ns
Minimum Reset Pulse Width	$PW_{RESET}$		62.5	10		ns
Minimum Output Enable Pulse Width	$PW_{ENABLE}$		1	0.55		μs
Minimum Latch Enable Pulse Width	$PW_{LATCH}$		62.5	38		ns
Clock Pulse Width	$PW_{SCK}$			38	62.5	ns

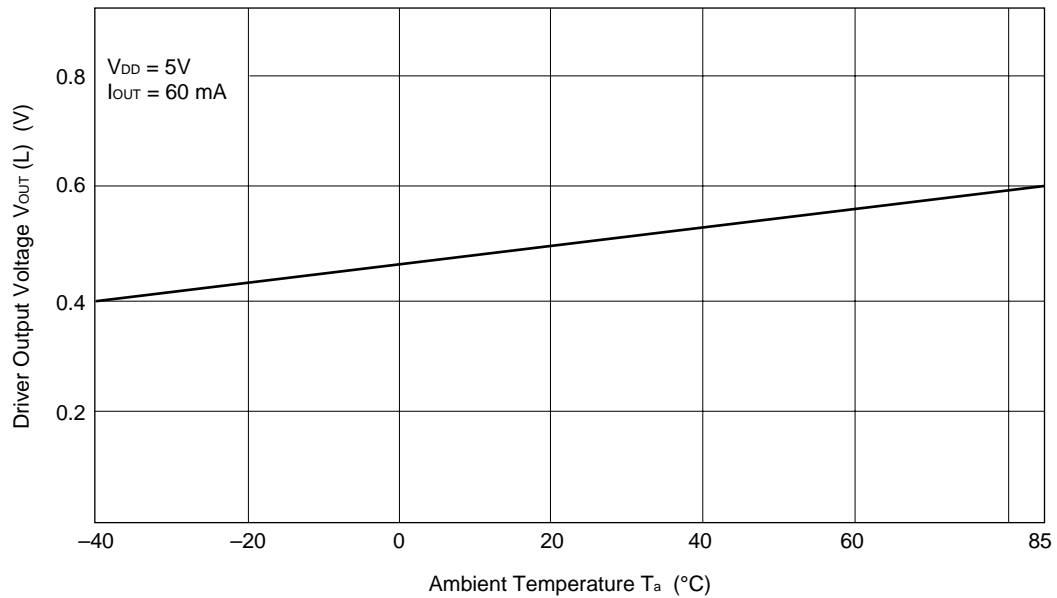
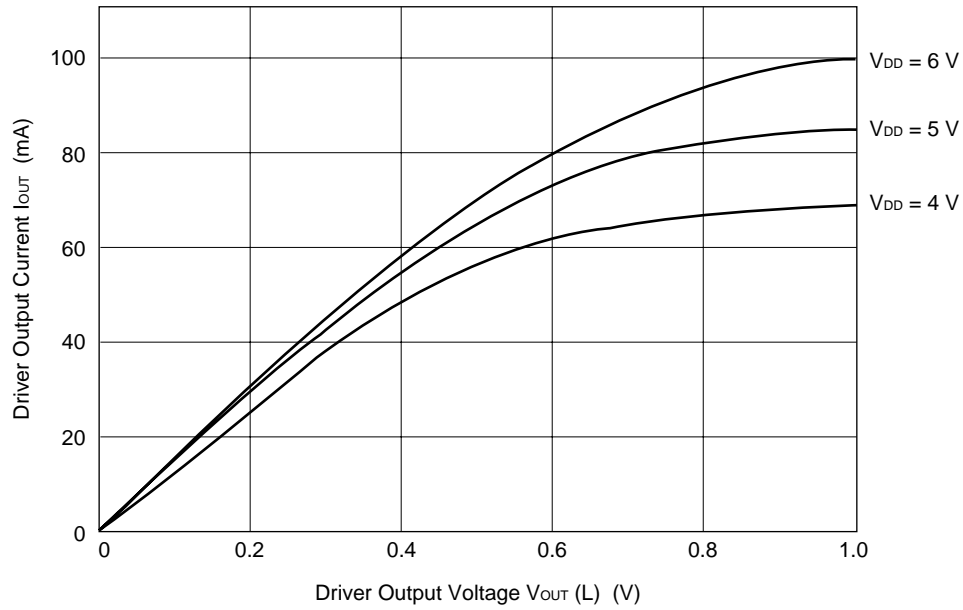
TIMING WAVEFORMS



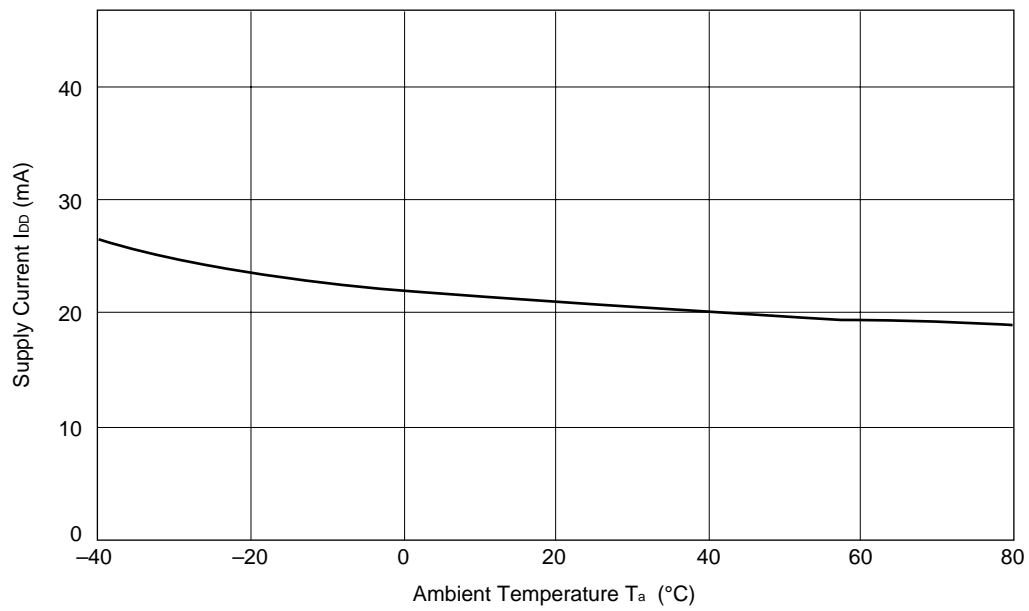
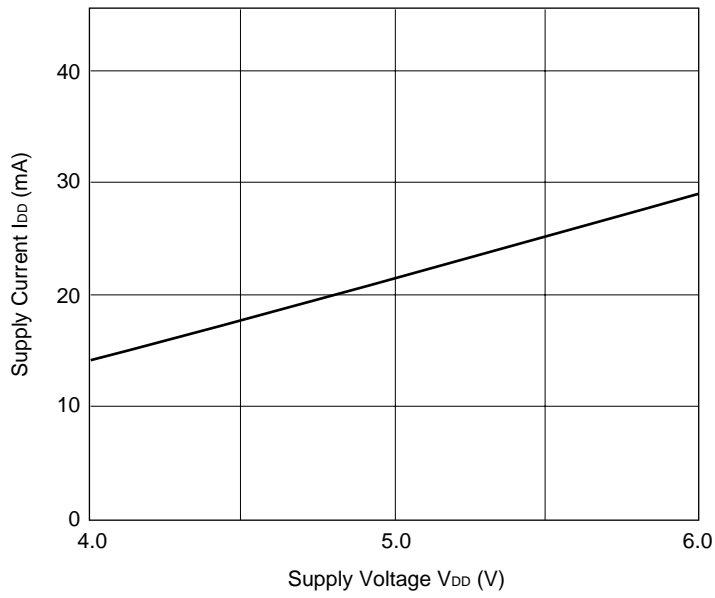


TYPICAL CHARACTERISTICS (T<sub>a</sub> = 25 °C)

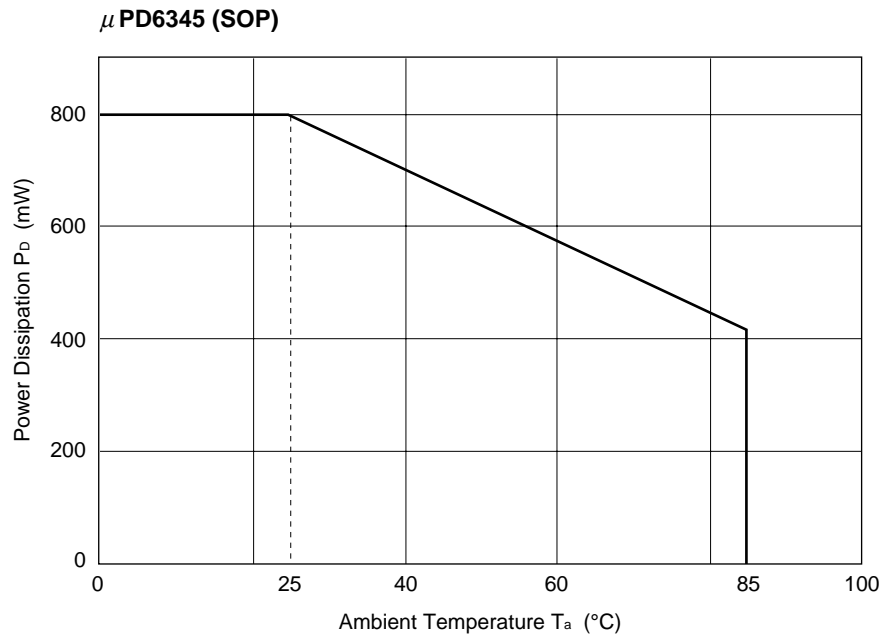
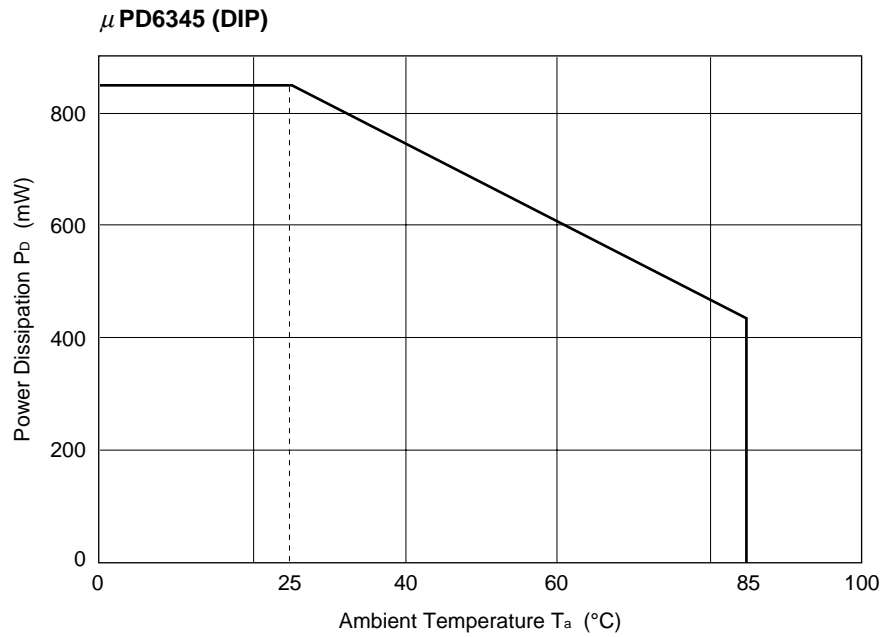
DRIVER OUTPUT CHARACTERISTICS



SUPPLY CURRENT CHARACTERISTICS (8 Outputs is all ON, No load)

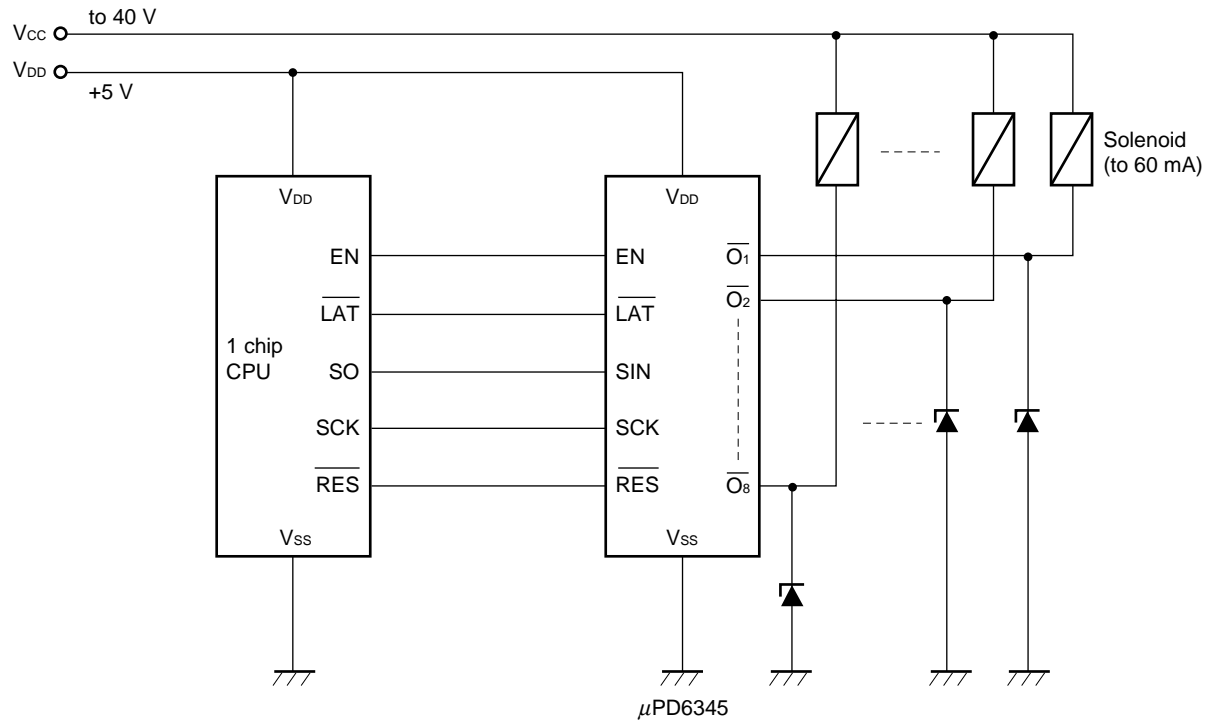


PACKAGE POWER DISSIPATION CHARACTERISTICS

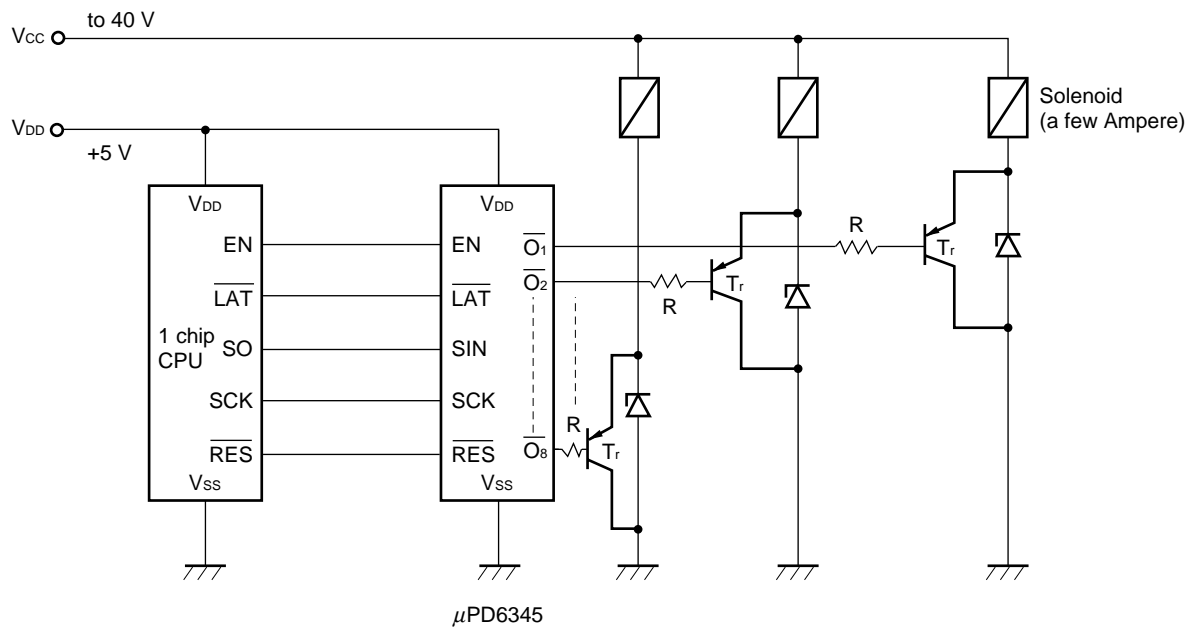


APPLICATION CIRCUIT

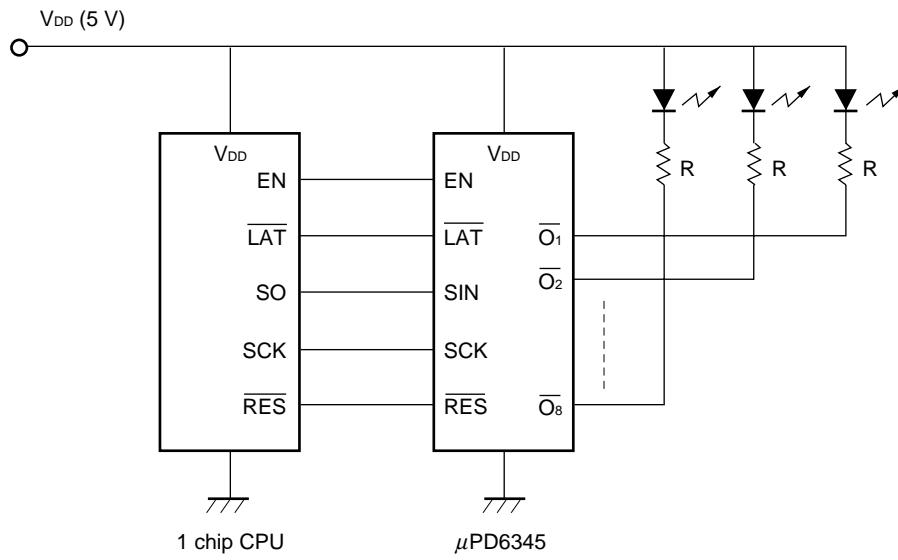
(1) Driving of Solenoid



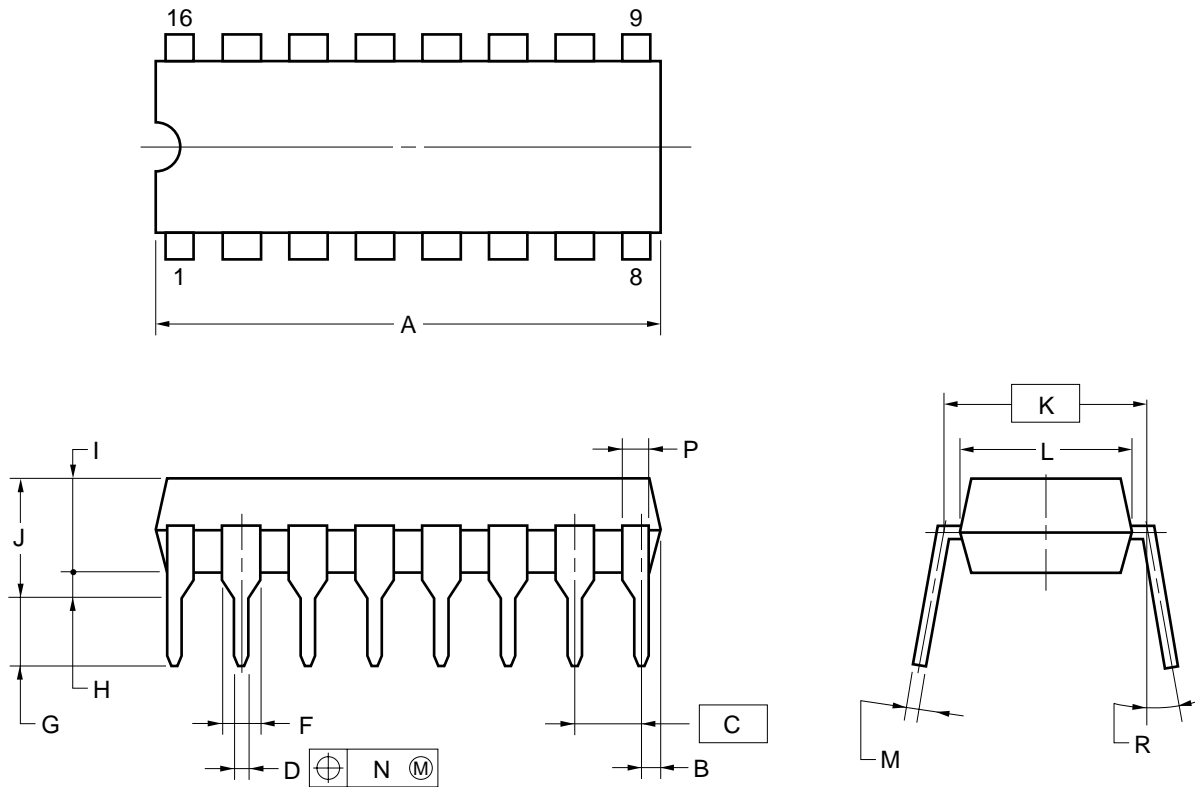
(2) Driving of Solenoid for High Current



(2) Driving of LED



16PIN PLASTIC DIP (300 mil)



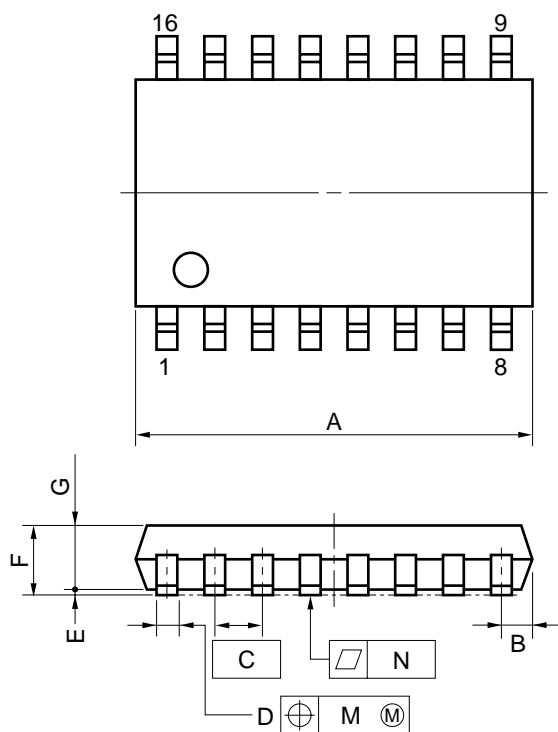
NOTES

- 1) Each lead centerline is located within 0.25 mm (0.01 inch) of its true position (T.P.) at maximum material condition.
- 2) Item "K" to center of leads when formed parallel.

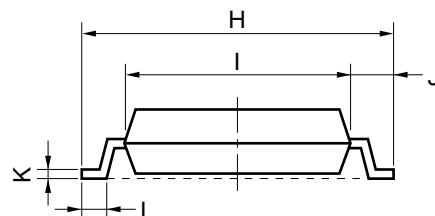
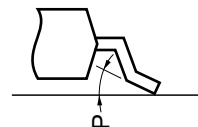
ITEM	MILLIMETERS	INCHES
A	20.32 MAX.	0.800 MAX.
B	1.27 MAX.	0.050 MAX.
C	2.54 (T.P.)	0.100 (T.P.)
D	0.50±0.10	0.020 <sup>+0.004</sup> <sub>-0.005</sub>
F	1.2 MIN.	0.047 MIN.
G	3.5±0.3	0.138±0.012
H	0.51 MIN.	0.020 MIN.
I	4.31 MAX.	0.170 MAX.
J	5.08 MAX.	0.200 MAX.
K	7.62 (T.P.)	0.300 (T.P.)
L	6.4	0.252
M	0.25 <sup>+0.10</sup> <sub>-0.05</sub>	0.010 <sup>+0.004</sup> <sub>-0.003</sub>
N	0.25	0.01
P	1.0 MIN.	0.039 MIN.
R	0~15°	0~15°

P16C-100-300A,C-1

16 PIN PLASTIC SOP (300 mil)



detail of lead end



NOTE

Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	10.46 MAX.	0.412 MAX.
B	0.78 MAX.	0.031 MAX.
C	1.27 (T.P.)	0.050 (T.P.)
D	0.40 <sup>+0.10</sup> <sub>-0.05</sub>	0.016 <sup>+0.004</sup> <sub>-0.003</sub>
E	0.1±0.1	0.004±0.004
F	1.8 MAX.	0.071 MAX.
G	1.55	0.061
H	7.7±0.3	0.303±0.012
I	5.6	0.220
J	1.1	0.043
K	0.20 <sup>+0.10</sup> <sub>-0.05</sub>	0.008 <sup>+0.004</sup> <sub>-0.002</sub>
L	0.6±0.2	0.024 <sup>+0.008</sup> <sub>-0.009</sub>
M	0.12	0.005
N	0.10	0.004
P	3° <sup>+7°</sup> <sub>-3°</sub>	3° <sup>+7°</sup> <sub>-3°</sub>

P16GM-50-300B-4

## [MEMO]

No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.

NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or others.

While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customers must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.

NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.

Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

Anti-radioactive design is not implemented in this product.