

$\mu$ PD6325,  $\mu$ PD6326,  $\mu$ PD6335,  $\mu$ PD6336QUAD/OCTAL 6BIT D/A CONVERTER  
CMOS LSI

## DESCRIPTION

$\mu$ PD6325 Serie are 6 bit D/A Converter for control volumn, brightness, contrast, color or tone of TV set.  
The data are transferring serially from micro-computer.

$\mu$ PD6325 Serie Line-up	QUAD D/A	OCTAL D/A
D/A output is consist of Emitter follower buffer	$\mu$ PD6325C, 6325G	$\mu$ PD6326C
Non buffer output	$\mu$ PD6335C, 6335G	$\mu$ PD6336C

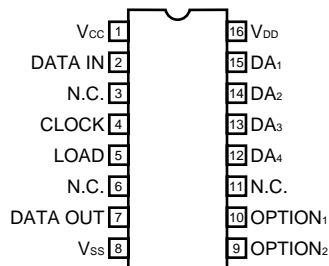
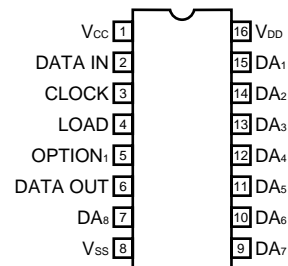
## FEATURES

- R-2R ladder D/A
- Serial Data input (DATA IN, CLOCK, LOAD)
- Power supply voltage of interface is 5 V ( $V_{CC}$ ) and D/A reference voltage is free ( $V_{CC}$  to 15 V).

## ORDERING INFORMATION

Part No.	Package
$\mu$ PD6325C	16-pin plastic DIP (300 mil)
$\mu$ PD6325G	16-pin plastic SOP (300 mil)
$\mu$ PD6326C	16-pin plastic DIP (300 mil)
$\mu$ PD6335C	16-pin plastic DIP (300 mil)
$\mu$ PD6335G	16-pin plastic SOP (300 mil)
$\mu$ PD6336C	16-pin plastic DIP (300 mil)

## PIN CONNECTION DIAGRAM (Top View)

 $\mu$ PD6325,  $\mu$ PD6335 $\mu$ PD6326,  $\mu$ PD6336

Block diagram of the internal architecture of the PD6325 and PD6326. The diagram shows a 12-bit Shift Register (D0 to D11) connected to a Level Shifter (CLOCK, DATA IN, LOAD), a Latch, and a Line Decoder. The Line Decoder outputs are connected to two 6-bit Latches, each followed by a 6-bit R-2R ladder D/A Converter. The D/A Converters are connected to VDD, VSS, and output pins DA1 and DA8. The output pins are also connected to a Level Shifter (DATA OUT, OPTION2, OPTION1).

\*A -----  $\mu$  PD6335,  $\mu$ PD6336  
B -----  $\mu$  PD6325,  $\mu$ PD6326

$\mu$ PD6325,  $\mu$ PD6326 have Quad D/As.

## PIN CONFIGURATION

Pin No.		Symbol	Pin Name	Function
$\mu$ PD 6325 6335	$\mu$ PD 6326 6336			
1	1	V <sub>CC</sub>	Interface Power Supply	This pin is used to interface with the control IC (ex. micro processor). Supply the voltage high level of the control IC.
2	2	DATA IN	Serial Data Input	Control data input terminal. Data is read in synchronization with the clocks input to the CLOCK terminal.
4	3	CLOCK	Shift Clock Input	Data read clock input terminal. The Data input to the DATA IN terminal is read at the leading edge of the clock.
5	4	LOAD	Load Pulse Input	This terminal is used to input Load signals after inputting serial data. 12 bit data is read after leading edge of a pulse input to the LOAD terminal.
7	6	DATA OUT	Serial Data Output	Serial data output terminal. The final stage data of 12 bit shift register appears on this terminal in synchronization with shift clock.
8	8	V <sub>SS</sub>	Ground	System ground.
9	—	OPTION <sub>2</sub>	Expansion Output Port	D <sub>7</sub> the data of the shift register appears on this terminal. (Only $\mu$ PD6325 and $\mu$ PD6335)
10	5	OPTION <sub>1</sub>	Expansion Output Port	D <sub>6</sub> the data of the shift register appears on this terminal.
—	7	DA <sub>8</sub>	Analog Output Channel 8	Analog Output
—	9	DA <sub>7</sub>	Analog Output Channel 7	Analog Output
—	10	DA <sub>6</sub>	Analog Output Channel 6	Analog Output
—	11	DA <sub>5</sub>	Analog Output Channel 5	Analog Output
12	12	DA <sub>4</sub>	Analog Output Channel 4	Analog Output
13	13	DA <sub>3</sub>	Analog Output Channel 3	Analog Output
14	14	DA <sub>2</sub>	Analog Output Channel 2	Analog Output
15	15	DA <sub>1</sub>	Analog Output Channel 1	Analog Output
16	16	V <sub>DD</sub>	Power Supply	Reference Voltage for D/A converters. Analog output voltage range is GND to V <sub>DD</sub> .

**ABSOLUTE MAXIMUM RATINGS ( $T_A = 25\text{ }^{\circ}\text{C}$ )**

Supply Voltage	$V_{DD}, V_{CC}$	$-0.5$ to $+18$ , $V_{CC} \leq V_{DD}$	V
Output Voltage	$V_{OUT}$	$-0.5$ to $V_{DD} + 0.5$	V
Input Voltage	$V_{IN}$	$-0.5$ to $V_{CC} + 0.5$	V
Input Current	$I_{IN}$	10	mA
Emitter Follower Current	$I_{OE}$	10	mA
Power Dissipation	$P_D$	500*/200**	mW
Operating Temperature	$T_A$	$-40$ to $+85$	$^{\circ}\text{C}$
Storage Temperature	$T_{stg}$	$-65$ to $+125$	$^{\circ}\text{C}$

\*DIP

\*\*SOP

**RECOMMENDED OPERATING CONDITIONS**

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITION
Supply Voltage	$V_{DD}$	$V_{CC}$		15	V	$V_{CC} \leq V_{DD}$
Supply Voltage of Interface	$V_{CC}$	4.5	5.0	5.5	V	$V_{CC} \leq V_{DD}$
Low Level Input Voltage	$V_{IL}$			0.8	V	$V_{CC} = 5\text{ V}$ , $V_{DD} = 5$ to $15\text{ V}$
High Level Input Voltage	$V_{IH}$	3.5			V	$V_{CC} = 5\text{ V}$ , $V_{DD} = 5$ to $15\text{ V}$
Only $\mu$ PD6325 & $\mu$ PD6326 Emitter Follower Power Dissipation 1	$P_E/\text{unit}$			5	mW	$T_A = 85\text{ }^{\circ}\text{C}$
Emitter Follower Power Dissipation 2	$P_E/\text{unit}$			15	mW	$T_A = 70\text{ }^{\circ}\text{C}$
Emitter Follower Power Dissipation 3	$P_E \text{ total}$			25	mW	$T_A = 85\text{ }^{\circ}\text{C}$
Emitter Follower Power Dissipation 4	$P_E \text{ total}$			75	mW	$T_A = 70\text{ }^{\circ}\text{C}$
TIMING CONDITIONS ( $T_A = -40$ to $+85\text{ }^{\circ}\text{C}$ , $V_{SS} = 0\text{ V}$ , $V_{CC} = 5\text{ V}$ , $V_{DD} = V_{CC}$ to $15\text{ V}$ )						
CLOCK High Level Width	$t_{CH}$	4.0			$\mu\text{s}$	
CLOCK Low Level Width	$t_{CL}$	10.0			$\mu\text{s}$	
CLOCK Rise Time	$t_{cr}$			1.0	$\mu\text{s}$	
CLOCK Fall Time	$t_{cf}$			1.0	$\mu\text{s}$	
DATA IN Setup Time	$t_{Dsetup}$	2			$\mu\text{s}$	
DATA IN Hold Time	$t_{Dhold}$	10			$\mu\text{s}$	
Pulse Width, LOAD High	$t_{W(LOAD)}$	4			$\mu\text{s}$	
LOAD Lead Time	$t_{Lead}$	10			$\mu\text{s}$	
LOAD Lag Time	$t_{Llag}$	10			$\mu\text{s}$	

# ELECTRICAL CHARACTERISTICS

( $T_A = -40$  to  $+85^\circ\text{C}$ ,  $V_{SS} = 0$  V,  $V_{CC} = 4.5$  to  $5.5$  V,  $V_{DD} = V_{CC}$  to  $15$  V)

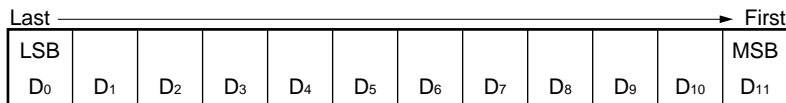
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITION
Current Consumption	$I_{DD}$			15	mA	No Load, for $\mu$ PD6326, 6336
Current Consumption	$I_{DD}$			10	mA	No Load, for $\mu$ PD6325, 6335
Current Consumption of Interface	$I_{CC}$			10	$\mu\text{A}$	No Load of DATA OUT, Static Consumption
Input Leak Current	$I_{ILEAK}$			$\pm 1$	$\mu\text{A}$	$V_{IN} = V_{CC}$ or $V_{SS}$
DATA OUT High Level Output Voltage	$I_{OH}$	-100			$\mu\text{A}$	$V_{OH} = V_{DD} - 0.5$ V
DATA OUT Low Level Output Voltage	$I_{OL}$	100			$\mu\text{A}$	$V_{OL} = 0.5$ V
Emitter Follower Leak Current	$I_{OLEAK}$			20	$\mu\text{A}$	for $\mu$ PD6325, 6326
Settling Time	$t_{DA\ set}$			10	$\mu\text{s}$	<b>Note</b>

**Note**  $\mu$ PD6325, 6326:  $R_L = 20$  k $\Omega$ ,  $C_L = 50$  pF

$\mu$ PD6335, 6336: No Load.

## DATA CONFIGURATION

Data Length is 12 bit.



D/A output CONTROL BIT

D <sub>11</sub>	D <sub>10</sub>	D <sub>9</sub>	D <sub>8</sub>	Select D/A	Target device
0	0	0	0	Don't Care	$\mu$ PD6325, 6326 $\mu$ PD6335, 6336
0	0	0	1	DA <sub>1</sub>	$\mu$ PD6325, 6326 $\mu$ PD6335, 6336
0	0	1	0	DA <sub>2</sub>	$\mu$ PD6325, 6326 $\mu$ PD6335, 6336
0	0	1	1	DA <sub>3</sub>	$\mu$ PD6325, 6326 $\mu$ PD6335, 6336
0	1	0	0	DA <sub>4</sub>	$\mu$ PD6325, 6326 $\mu$ PD6335, 6336
0	1	0	1	DA <sub>5</sub>	$\mu$ PD6326 $\mu$ PD6336
0	1	1	0	DA <sub>6</sub>	$\mu$ PD6326 $\mu$ PD6336
0	1	1	1	DA <sub>7</sub>	$\mu$ PD6326 $\mu$ PD6336
1	0	0	0	DA <sub>8</sub>	$\mu$ PD6326 $\mu$ PD6336
1	×	×	×	Don't Care	$\mu$ PD6325, 6326 $\mu$ PD6335, 6336

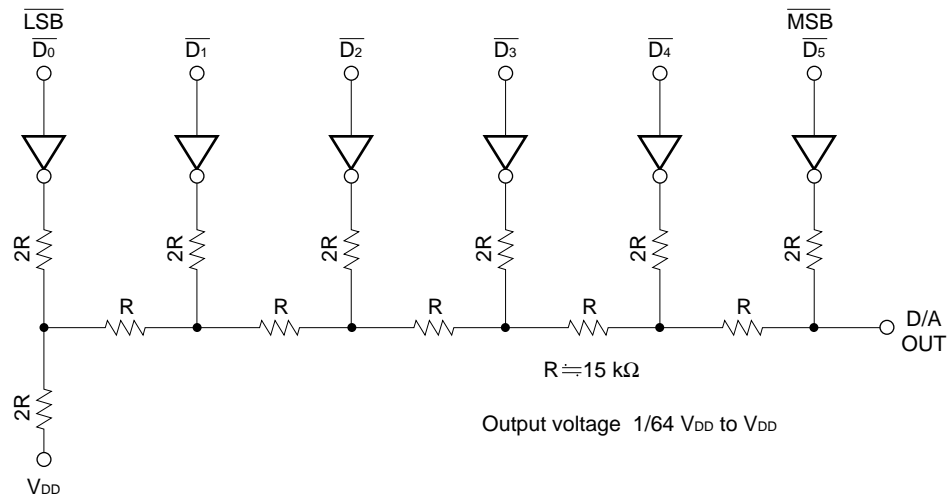
OPTION output CONTROL BIT

D <sub>7</sub>	D <sub>6</sub>	OPTION <sub>1</sub> out.	OPTION <sub>2</sub> out.	Note
0	0	L	L	OPTION2 is only $\mu$ PD6325, 6326
0	1	H	L	OPTION2 is only $\mu$ PD6325, 6326
1	0	L	H	OPTION2 is only $\mu$ PD6325, 6326
1	1	H	H	OPTION2 is only $\mu$ PD6325, 6326

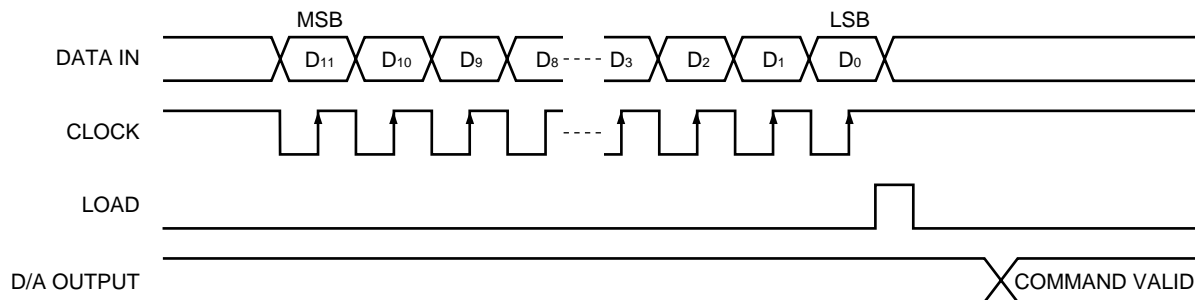
D/A Output Voltage CONTROL BIT

D <sub>5</sub>	D <sub>4</sub>	D <sub>3</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>0</sub>	Output Voltage
0	0	0	0	0	0	$\Rightarrow V_{DD}/64$
0	0	0	0	0	1	$\Rightarrow 2 \times V_{DD}/64$
0	0	0	0	1	0	$\Rightarrow 3 \times V_{DD}/64$
0	0	0	0	1	1	$\Rightarrow 4 \times V_{DD}/64$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
1	1	1	1	1	0	$\Rightarrow 63 \times V_{DD}/64$
1	1	1	1	1	1	$\Rightarrow V_{DD}$

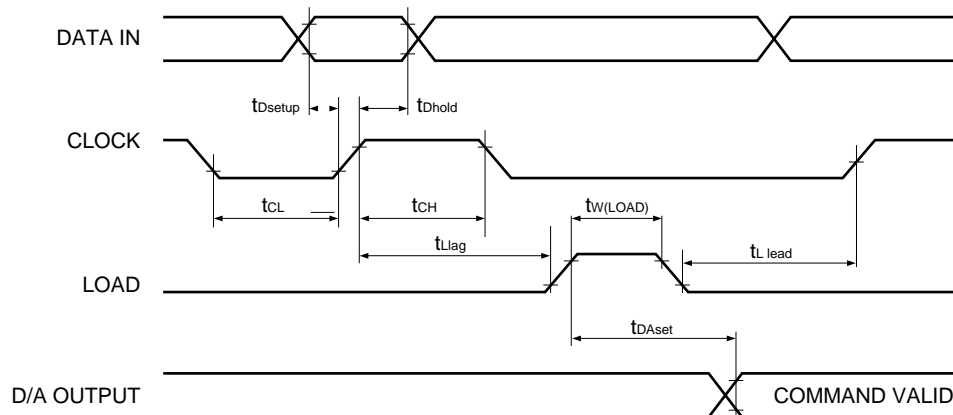
# EQUIVALENT CIRCUIT OF 6 bit D/A



# TIMING CHART

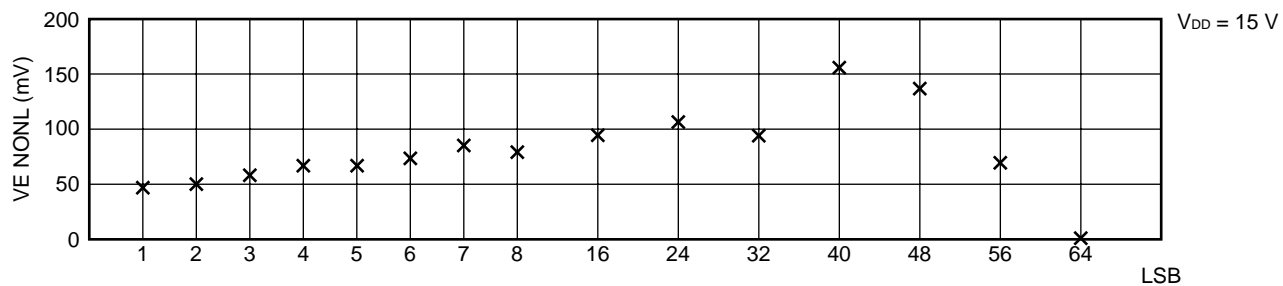
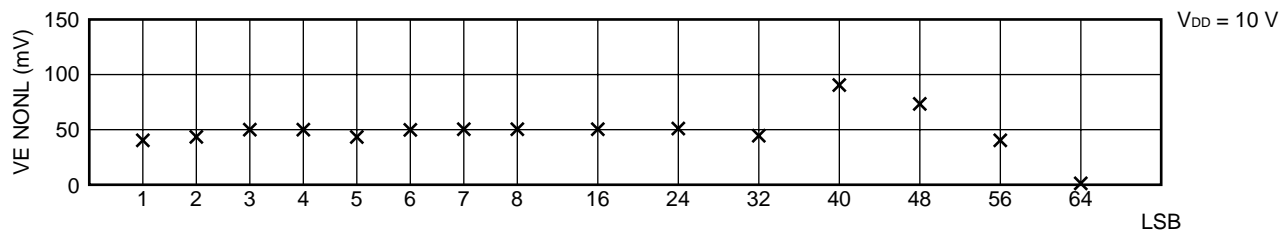
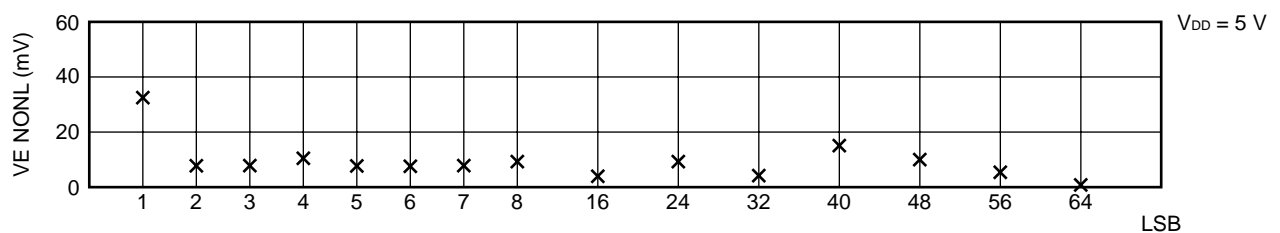


Data is loaded when LOAD is high level.

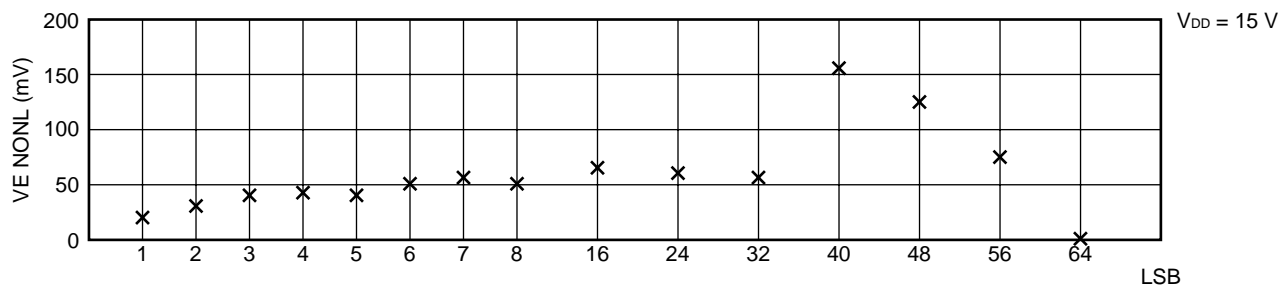
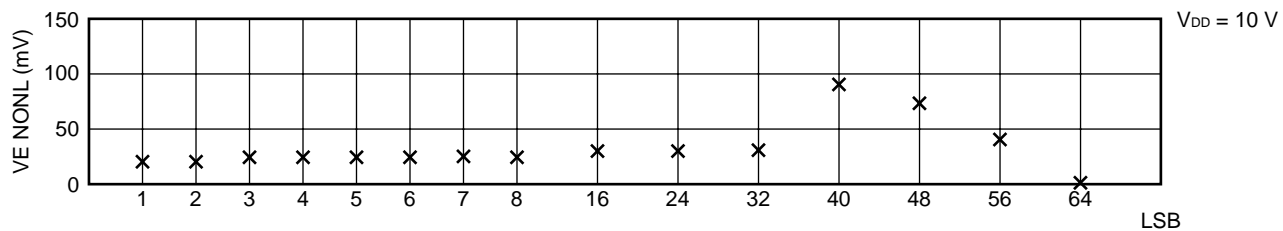
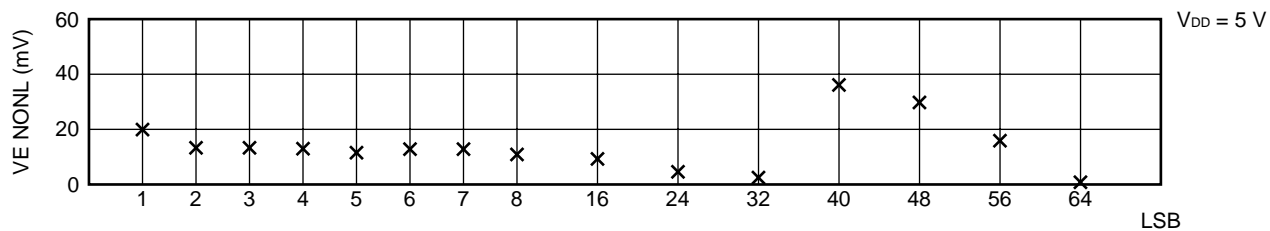


**LINEARITY OF D/A OUTPUT ( $\mu$ PD6335, 6336) (TYP.)**

• $T_A = -40^\circ\text{C}$

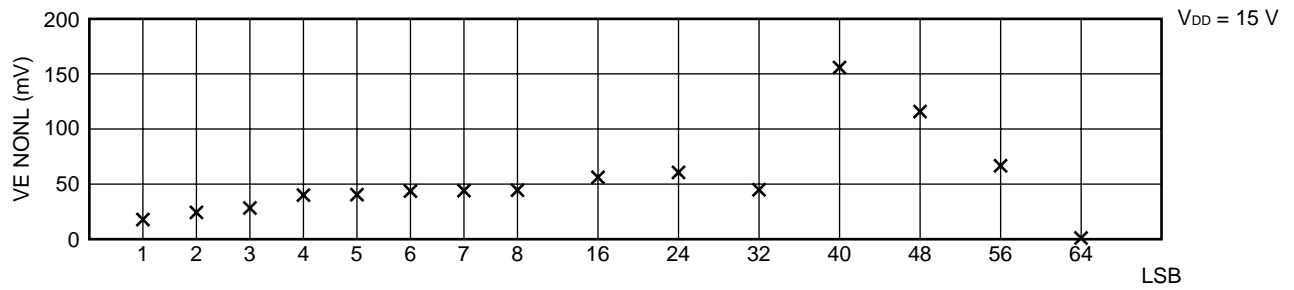
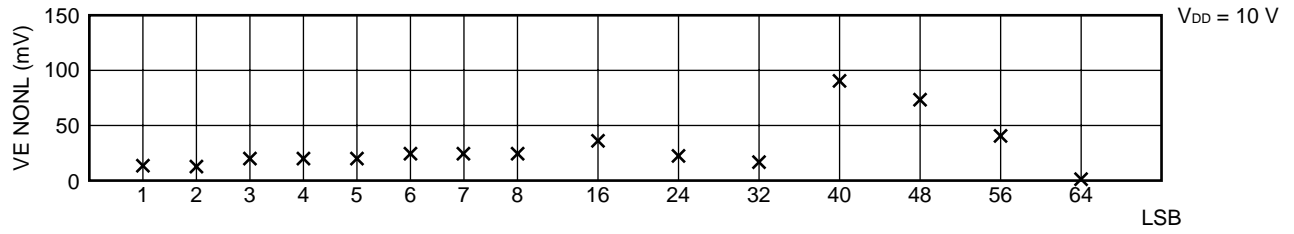
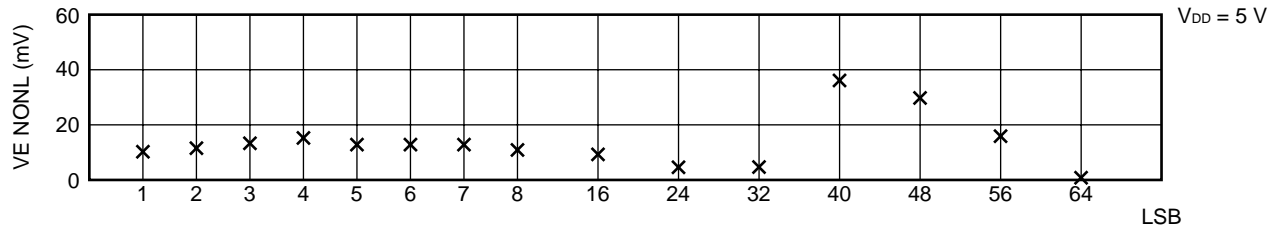


• $T_A = 25^\circ\text{C}$

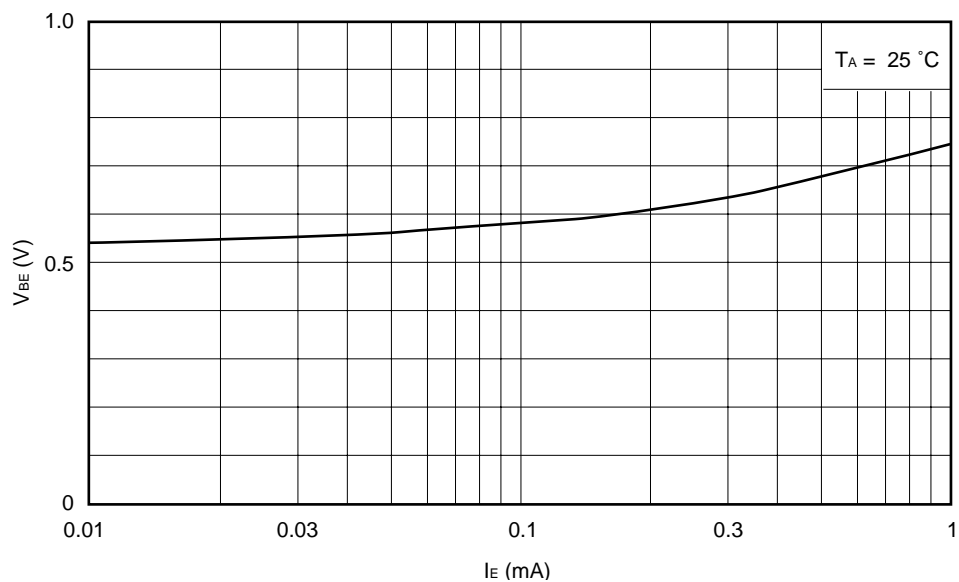
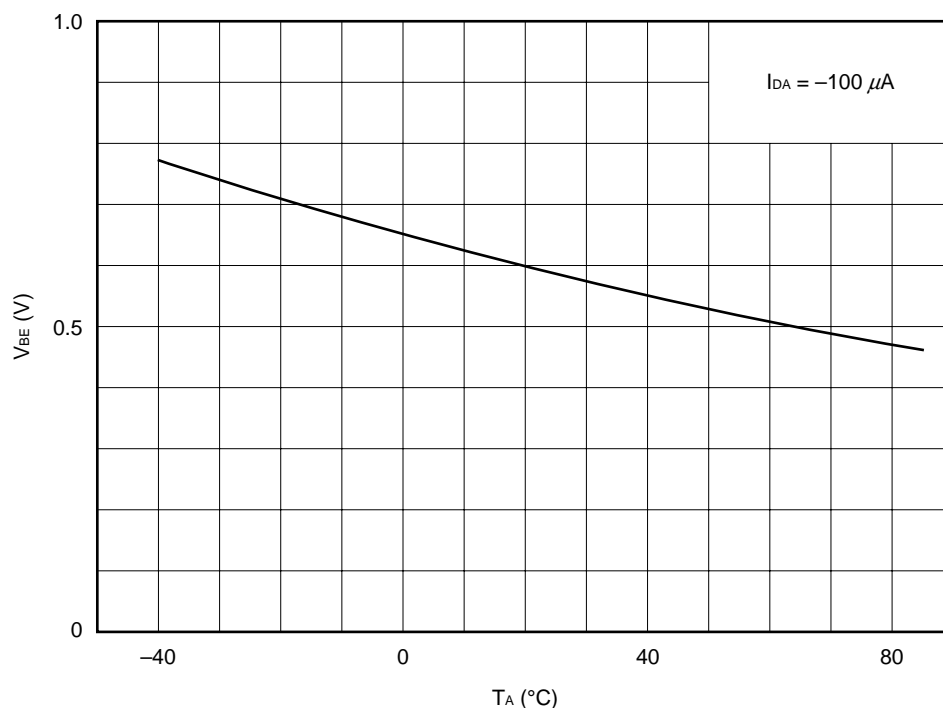




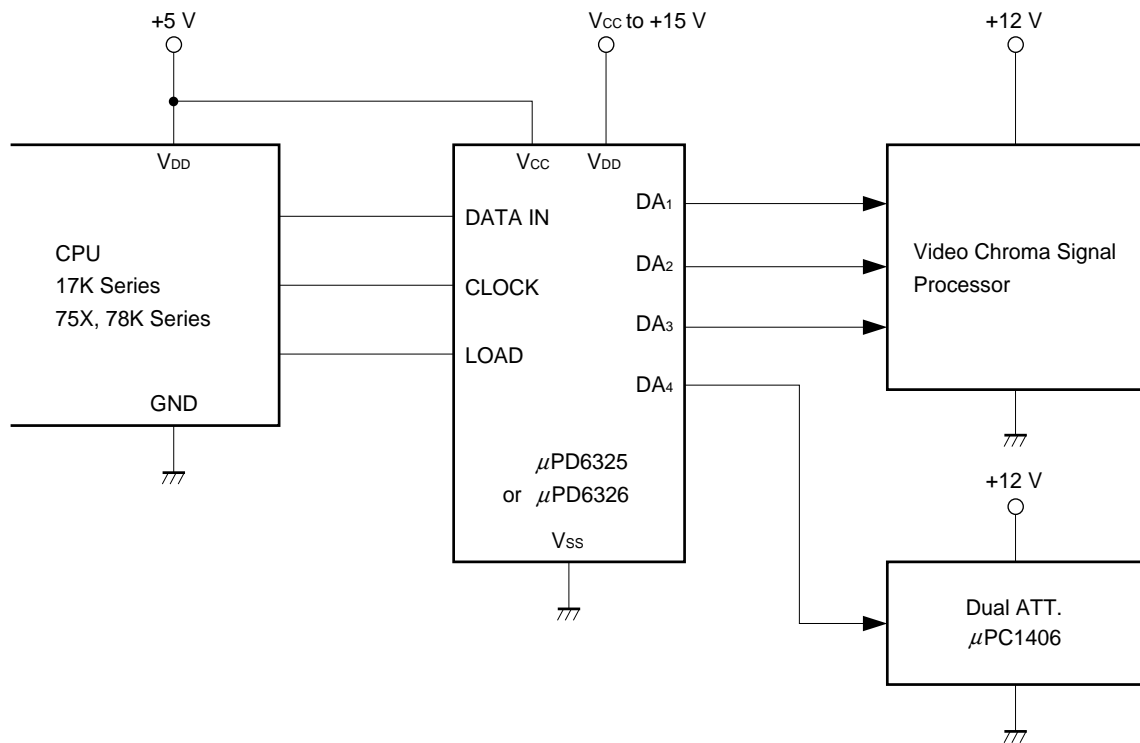
•  $T_A = 85\text{ }^{\circ}\text{C}$



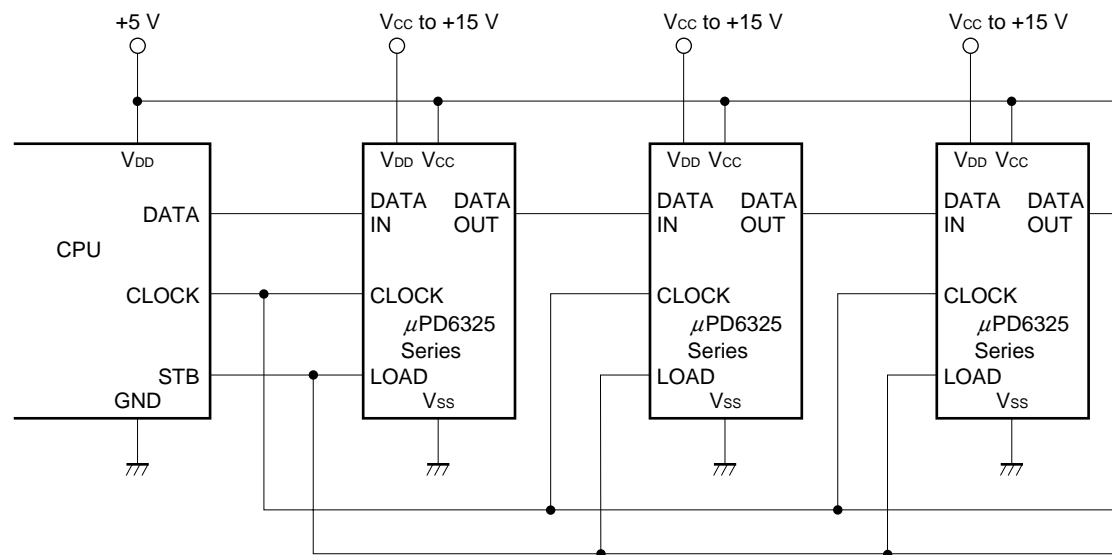
\*  $VE\ NONL = (MEASUREMENT\ VALUE) - (IDEAL\ VALUE)$

Characteristics of Emitter follower buffer ( $\mu$ PD6325, 6326)(1)  $V_{BE} - I_E$  (including R-2R's resistor)(2)  $V_{BE} - T_A$ 

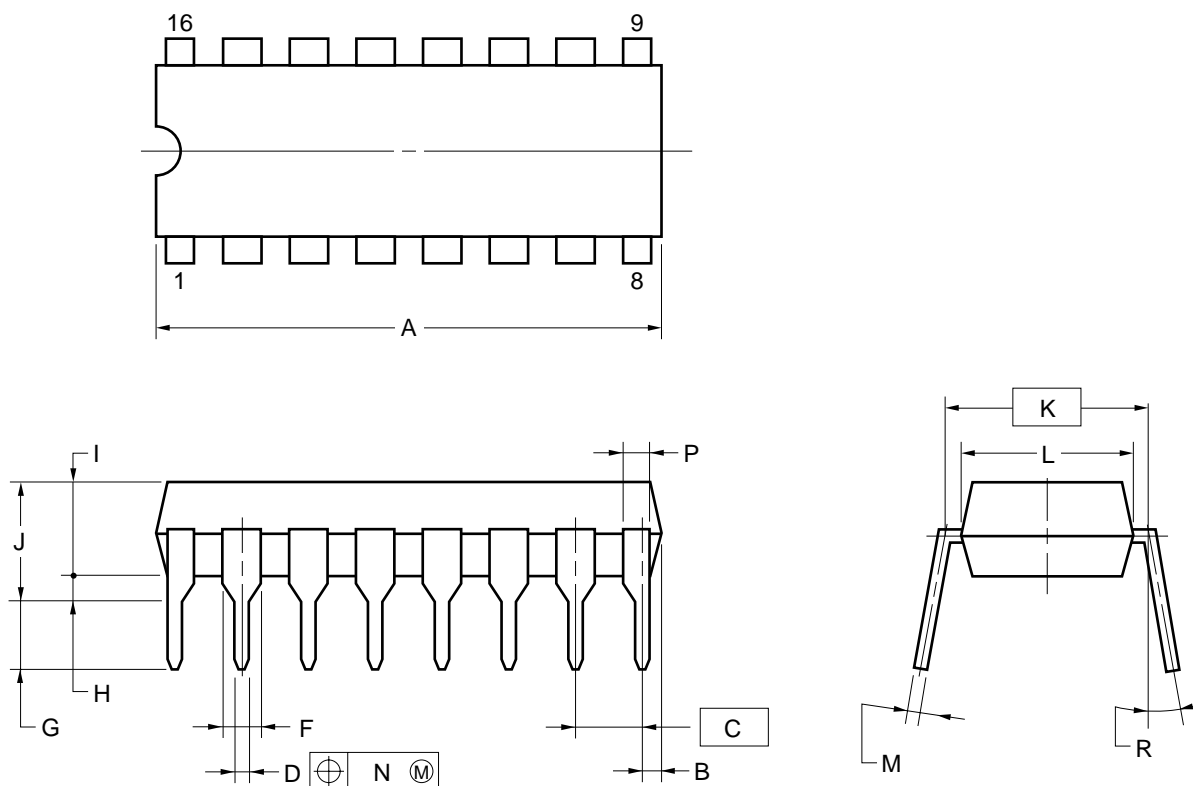
## APPLICATION FOR TV SET



## APPLICATION FOR CASCADE CONNECTING



## 16PIN PLASTIC DIP (300 mil)



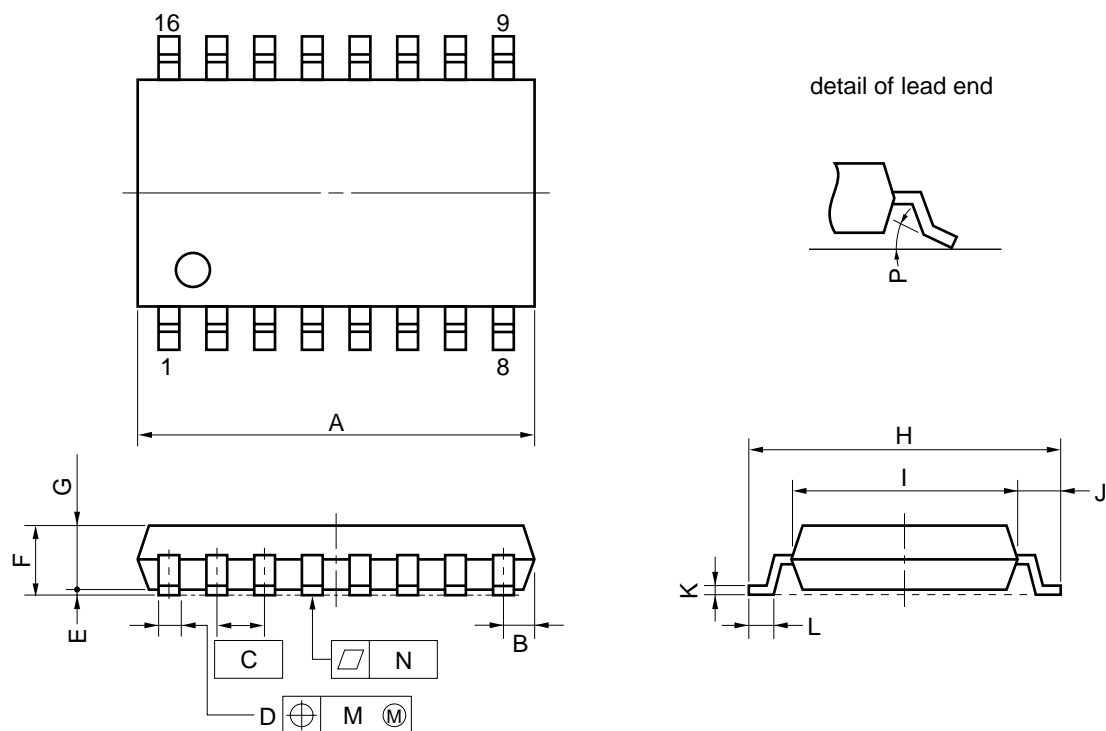
## NOTES

- 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)

**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

# REFERENCE

Document Name	Document No.
NEC semiconductor device reliability/quality control system	IEI-1212
Quality grade on NEC semiconductor devices	C11531E
Semiconductor device mounting technology manual	C10535E
Semiconductor device package manual	C10943X
Guide to quality assurance for semiconductor devices	MEI-1202
Semiconductor selection guide	X10679E

[MEMO]

## [MEMO]

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

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