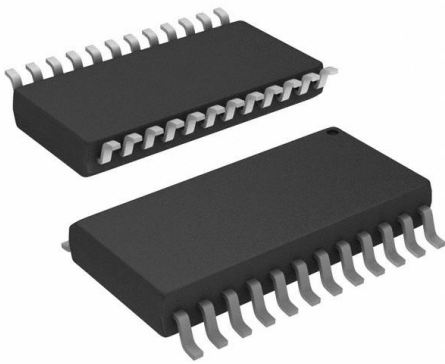


STP16CPC26MTR Datasheet

www.digi-electronics.com



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DiGi Electronics Part Number	STP16CPC26MTR-DG
Manufacturer	STMicroelectronics
Manufacturer Product Number	STP16CPC26MTR
Description	IC LED DRVR LIN ANALOG 90MA 24SO
Detailed Description	LED Driver IC 16 Output Linear Shift Register Analog Dimming 90mA 24-SO

This model STP16CPC26MTR is available at DiGi Electronics.

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Manufacturer Product Number:

STP16CPC26MTR

Series:

-

Type:

Linear

Internal Switch(s):

Yes

Voltage - Supply (Min):

3V

Voltage - Output:

20V

Frequency:

30MHz

Applications:

Lighting

Mounting Type:

Surface Mount

Supplier Device Package:

24-SO

Manufacturer:

STMicroelectronics

Product Status:

Active

Topology:

Shift Register

Number of Outputs:

16

Voltage - Supply (Max):

5.5V

Current - Output / Channel:

90mA

Dimming:

Analog

Operating Temperature:

-40°C ~ 125°C (TA)

Package / Case:

24-SOIC (0.295", 7.50mm Width)

Base Product Number:

STP16CPC26

Environmental & Export classification

RoHS Status:

ROHS3 Compliant

REACH Status:

REACH Unaffected

HTSUS:

8542.39.0001

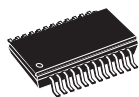
Moisture Sensitivity Level (MSL):

1 (Unlimited)

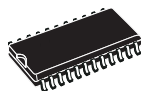
ECCN:

EAR99

Low voltage 16-bit constant current LED sink driver



QSOP-24



SO-24



TSSOP24

TSSOP24
(exposed pad)

Maturity status link

[STP16CPC26](#)

Features

- 16 constant current output channels
- Adjustable output current through external resistor
- Output current: 5 mA to 90 mA
- $\pm 1\%$ typical current accuracy bit to bit
- Max clock frequency: 30 MHz
- 20 V current generators rated voltage
- 3 - 5.5 V power supply
- Thermal shutdown for overtemperature protection

Applications

- Video display panel LED driver
- Special lighting

Description

The **STP16CPC26** is a monolithic, low voltage, 16-bit constant current LED sink driver. The device contains a 16-bit shift register and data latches, which convert serial input data into parallel output format. In the output stage sixteen regulated current generators provide 5 mA to 90 mA constant current to drive LEDs. The current is externally adjusted through a resistor. LED brightness can be adjusted from 0% to 100% via OE pin.

The **STP16CPC26** guarantees a 20 V driving capability, allowing users to connect more LEDs in series to each current source.

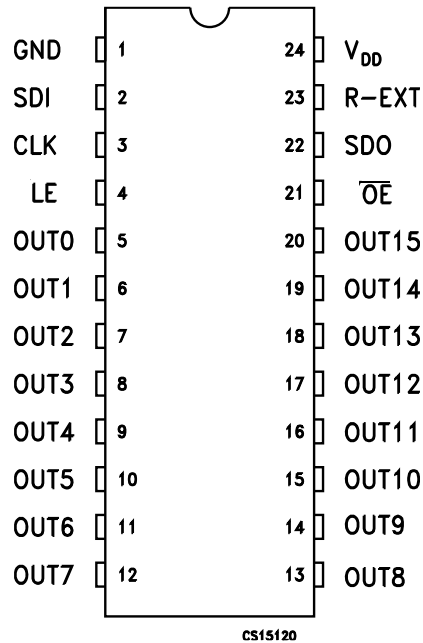
The high 30 MHz clock frequency makes the device suitable for high data rate transmission.

The thermal shutdown (170 °C with about 15 °C hysteresis) assures protection from overtemperature events.

The **STP16CPC26** is housed in four different packages: QSOP24, SO-24, TSSOP-24 and HTSSOP-24 (with exposed pad).

1 Pin description

Figure 1. Pin connection



GIPD140320161440MT

Note: The exposed-pad (if present) should be electrically connected to a metal land electrically isolated or connected to ground.

Table 1. Pin description

Pin n°	Symbol	Name and function
1	GND	Ground terminal
2	SDI	Serial data input terminal
3	CLK	Clock input terminal
4	LE	Latch input terminal
5-20	OUT 0-15	Output terminal
21	\overline{OE}	Input terminal of output enable (active low)
22	SDO	Serial data out terminal
23	R-EXT	Input terminal for an external resistor for constant current programming
24	V _{DD}	Supply voltage terminal



2 Electrical ratings

2.1 Absolute maximum ratings

Stressing the device above the rating listed in the “absolute maximum ratings” table may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DD}	Supply voltage	0 to 7	V
V_O	Output voltage	-0.5 to 20	V
I_O	Output current	90	mA
V_I	Input voltage	-0.4 to $V_{DD}+0.4$	V
I_{GND}	GND terminal current	1600	mA
ESD	Electrostatic discharge protection HBM human body model	± 2	kV
f_{CLK}	Clock frequency	30	MHz

2.2 Thermal data

Table 3. Thermal data

Symbol	Parameter	Value	Unit	
T_A	Operating free-air temperature range	-40 to +125	°C	
T_{OPR}	Operating temperature range	-40 to +150	°C	
T_{STG}	Storage temperature range	-55 to +150	°C	
R_{thJA}	Thermal resistance junction-ambient ⁽¹⁾	SO-24	60	°C/W
		TSSOP24	85	°C/W
		TSSOP24 exposed pad ⁽²⁾	37.5	°C/W
		QSOP-24	72	°C/W

1. According with JEDEC standard 51-7.

2. The exposed pad should be soldered directly to the PCB to realize the thermal benefits.



3 Electrical characteristics

$V_{DD} = 3.3\text{ V} - 5\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, unless otherwise specified.

Table 4. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{dd}	Supply voltage		3		5.5	V
V_{IH}	Input voltage high level		$0.8 \cdot V_{dd}$	-	V_{dd}	
V_{IL}	Input voltage low level		GND	-	$0.2 \cdot V_{dd}$	
V_{OL}	(SDO) ⁽¹⁾	$I_{OH} = -1\text{ mA}$	-	-	0.4	
V_{OH}	Serial data output voltage	$I_{OL} = +1\text{ mA}$	$V_{DD} - 0.4$	-	-	
I_{OH}	Output leakage current	$V_o = 20\text{ V}$, $Outn = \text{OFF}$	-	-	0.5	μA
ΔI_{OL1}	Current accuracy channel to channel ^{(2) (3)}	$V_{ds} = 0.3\text{ V}$, $R_{EXT} = 900\ \Omega$, $I_{OL} = 22\text{ mA}$	-	± 1	± 3	%
ΔI_{OL2}		$V_{ds} = 0.6\text{ V}$, $R_{EXT} = 360\ \Omega$, $I_{OL} = 55\text{ mA}$	-	± 1	± 3	
D_{IOL3}	Current accuracy device to device ⁽²⁾	$V_{ds} = 0.3\text{ V}$, $R_{EXT} = 900\ \Omega$, $I_{OL} = 22\text{ mA}$	-	-	± 6	%
ΔI_{OL4}		$V_{ds} = 0.6\text{ V}$, $R_{EXT} = 360\ \Omega$, $I_{OL} = 55\text{ mA}$	-	-	± 6	
$R_{IN(up)}$	Pull-up resistor for OE pin		250	500	800	$\text{k}\Omega$
$R_{IN(down)}$	Pull-down resistor for LE pin		250	500	800	
$I_{DD(OFF1)}$	Supply current (OFF)	$R_{EXT} = \text{OPEN}$ $OUT\ 0\ \text{to}\ 15 = \text{OFF}$	-	3	7	mA
$I_{DD(OFF2)}$		$R_{EXT} = 900\ \Omega$ $OUT\ 0\ \text{to}\ 15 = \text{OFF}$	-	7	10	
$I_{DD(OFF3)}$		$R_{EXT} = 360\ \Omega$ $OUT\ 0\ \text{to}\ 15 = \text{OFF}$	-	11	13.5	
$I_{DD(ON1)}$	Supply current (ON)	$R_{EXT} = 900\ \Omega$ $OUT\ 0\ \text{to}\ 15 = \text{ON}$	-	7	11	
$I_{DD(ON2)}$		$R_{EXT} = 360\ \Omega$ $OUT\ 0\ \text{to}\ 15 = \text{ON}$	-	11	15	
$\%/dV_{DS}$	Output current vs. output voltage regulation	V_{DS} from 1.0 V to 3.0 V $I_o = 22\text{ mA}$ $I_o = 55\text{ mA}$	-	± 0.1	-	$\%/V$
$\%/dV_{DD}$	Output current vs. supply voltage regulation ⁽⁴⁾	$I_o = 22\text{ mA}$; $V_{DS} = 0.3\text{ V}$ $I_o = 55\text{ mA}$; $V_{DS} = 0.6\text{ V}$	-	± 1	-	$\%/V$
Tsd	Thermal shutdown		-	170	-	$^\circ\text{C}$
Tsd-hy	Thermal shutdown hysteresis ⁽⁴⁾		-	15	20	

1. Specification referred to T_J from $-40\text{ }^\circ\text{C}$ to $+125\text{ }^\circ\text{C}$. Specification over the -40 to $+125\text{ }^\circ\text{C}$ T_J temperature range are assured by design, characterization and statistical correlation.
2. Tested with just one output ON.
3. $\Delta I_{OL+} = ((I_{OLmax} - I_{OLmean}) / I_{OLmean}) * 100$, $D_{IOL-} = ((I_{OLmin} - I_{OLmean}) / I_{OLmean}) * 100$, where $I_{OLmean} = (I_{OLout1} + I_{OLout2} + \dots + I_{OLout16}) / 16$.
4. Guaranteed by design.


 $V_{DD} = 3.3\text{ V} - 5\text{ V}$, $T_j = 25\text{ }^\circ\text{C}$, unless otherwise specified.

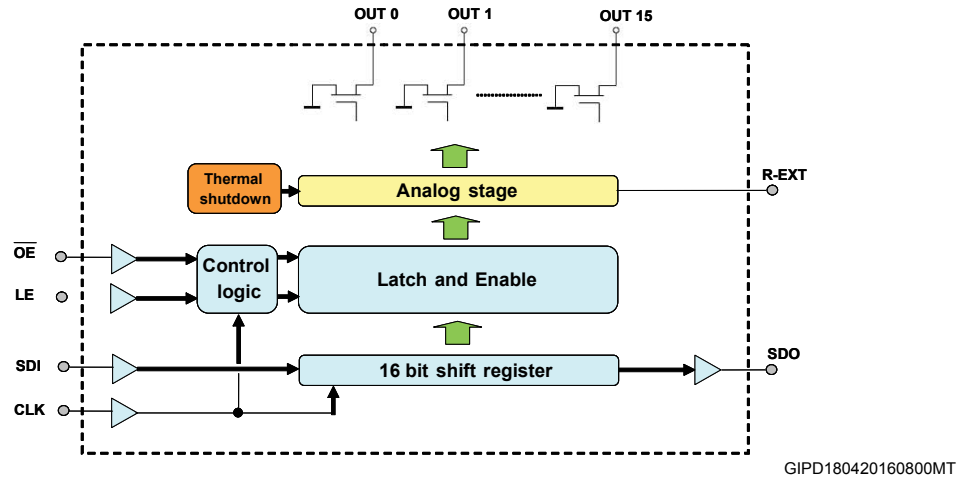
Table 5. Switching characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
f_{clk}	Clock frequency		-	-	30	MHz	
t_{PLH1}	CLK - OUTn	$V_{DS} = 0.8\text{ V}$ $V_{IH} = V_{DD}$ $V_{IL} = GND$ $R_{EXT} = 900\ \Omega$ $R_L = 50\ \Omega$ $C_L = 10\text{ pF}$	-	100	-	ns	
t_{PLH2}	LE - OUTn		-	100	-		
t_{PLH3}	OE - OUTn		-	100	-		
t_{PLHa}	CLK - SDO		$V_{DD} = 3.3\text{ V}$	-	30		-
t_{PLHb}			$V_{DD} = 5\text{ V}$	-	20		-
t_{PHL1}	CLK - OUTn		-	28	-		
t_{PHL2}	LE - OUTn		-	28	-		
t_{PHL3}	OE - OUTn		-	25	-		
t_{PHLa}	CLK - SDO		$V_{DD} = 3.3\text{ V}$	-	30		-
t_{PHLb}			$V_{DD} = 5\text{ V}$	-	20		-
$t_{w(CLK)}$	CLK		Pulse width	20	-		-
$t_{w(L)}$	LE			20	-		-
$t_{w(OE)}$	OE			150	-		-
$t_{su(L)}$	Setup time for LE			5	-		-
$t_{h(L)}$	Hold time for LE		5	-	-		
$t_{su(D)}$	Setup time for SDI		5	-	-		
$t_{h(D)}$	Hold time for SDI		10	-	-		
$t_r^{(1)}$	Maximum CLK rise time		-	-	5000		
$t_f^{(1)}$	Maximum CLK fall time		-	-	5000		
t_{or1a}	Output rise time of Vout	$V_{IH} = V_{DD}$, $V_{IL} = GND$	$V_{DD} = 3.3\text{ V}$	-	95	-	
t_{or1b}	Output rise time of Vout		$V_{DD} = 5\text{ V}$	-	85	-	
t_{of1a}	Output fall time of Vout	$V_{DS} = 0.8\text{ V}$, $R_L = 50\ \Omega$	$V_{DD} = 3.3\text{ V}$	-	40	-	
t_{of1b}	Output fall time of Vout	$C_L = 10\text{ pF}$ $I_{out} = 22\text{ mA}$	$V_{DD} = 5\text{ V}$	-	25	-	
t_{or2a}	Output rise time of Vout	$V_{IH} = V_{DD}$, $V_{IL} = GND$	$V_{DD} = 3.3\text{ V}$	-	80	-	
t_{or2b}	Output rise time of Vout		$V_{DD} = 5\text{ V}$	-	70	-	
t_{of2a}	Output fall time of Vout	$V_{DS} = 0.8\text{ V}$ $R_L = 50\ \Omega$	$V_{DD} = 3.3\text{ V}$	-	40	-	
t_{of2b}	Output fall time of Vout	$C_L = 10\text{ pF}$ $I_{out} = 55\text{ mA}$	$V_{DD} = 5\text{ V}$	-	30	-	
I_{out-ov}	Output current turn-on overshoot	$V_{DS} = 0.6\text{ to }3\text{ V}$ $C_L = 10\text{ pF}$ $I_{out} = 5\text{ to }60\text{ mA}$	-	-	0	%	

1. If devices are connected in cascade and t_r or t_f is large, it may be critical to achieve the timing required for data transfer between two cascaded devices.

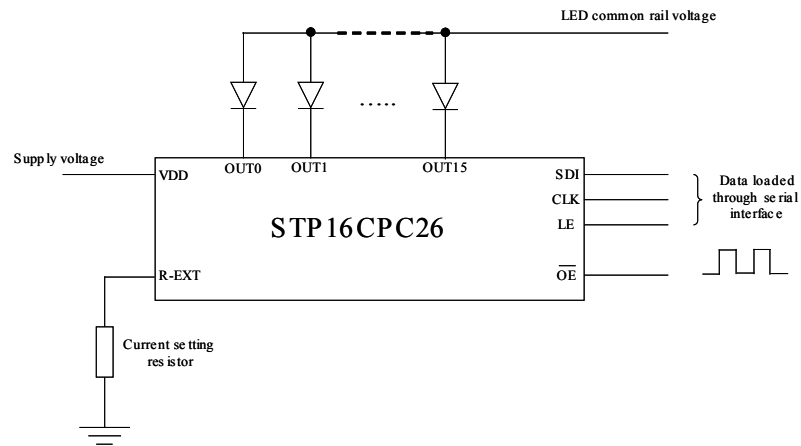
4 Simplified internal block diagram

Figure 2. STP16CPC26 simplified block diagram



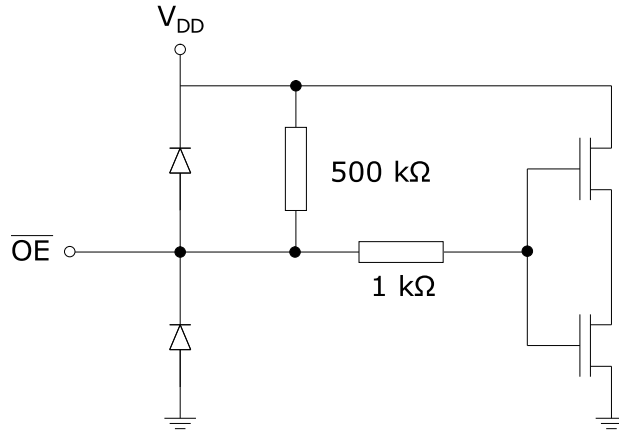
5 Typical application circuit

Figure 3. Typical application circuit

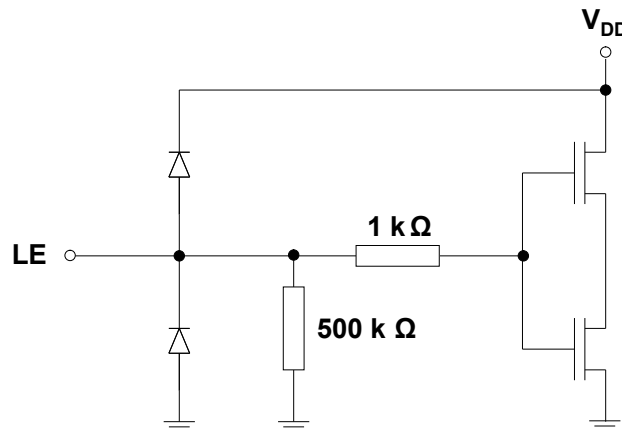


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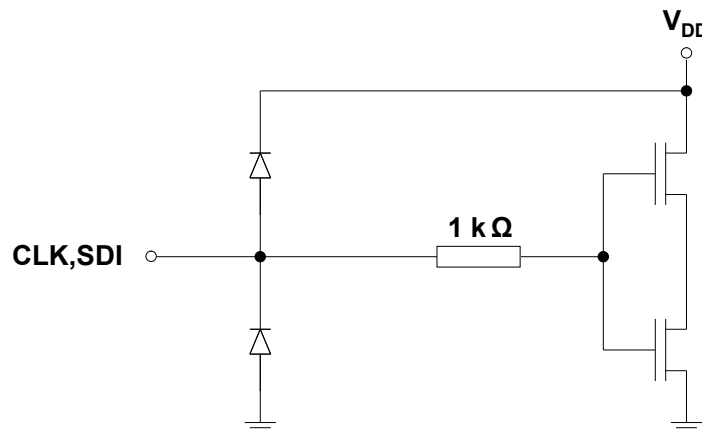
6 Equivalent circuit of inputs and outputs

Figure 4. \overline{OE} terminal


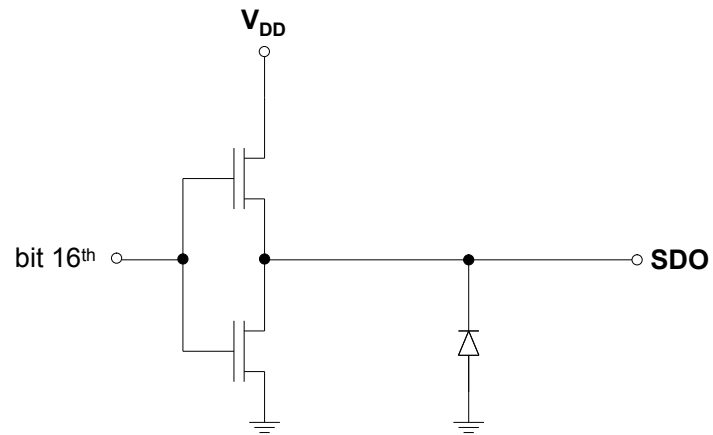
AMG280420160941MT

Figure 5. LE terminal


AMG280420160942MT

Figure 6. CLK, SDI terminal


AMG280420160943MT

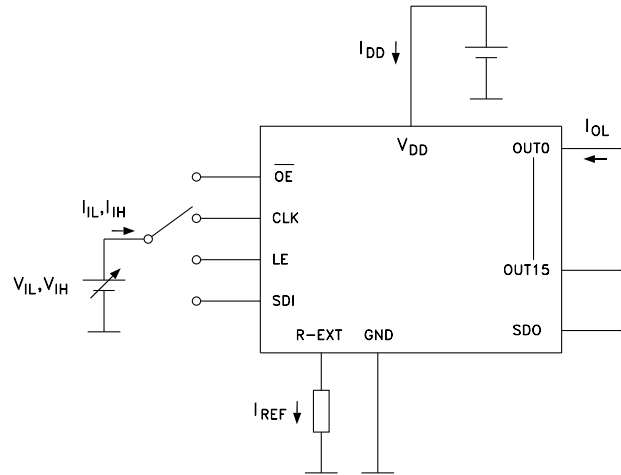
**Figure 7. SDO terminal**

AMG200220170900MT

7 Typical test circuits

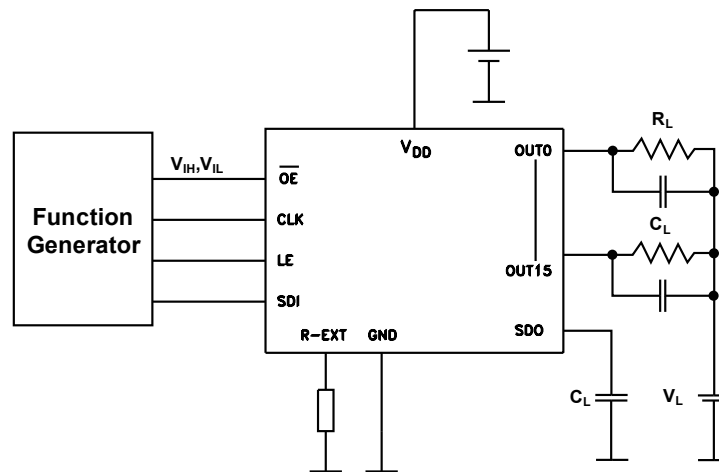
Figure 8 and Figure 9 show respectively the typical test circuit used measuring electrical (e.g. input voltage high/low level, output leakage current, supply current, etc.) and switching characteristics (propagation delays, set-up and hold time, rise and fall time of V_{OUT} , etc.). The resistor R_L and capacitor C_L in parallel connected to each output in Figure 8 simulate a LED behavior.

Figure 8. Typical test circuit for electrical characteristics



GIPD180420160819MT

Figure 9. Typical test circuit for switching characteristics



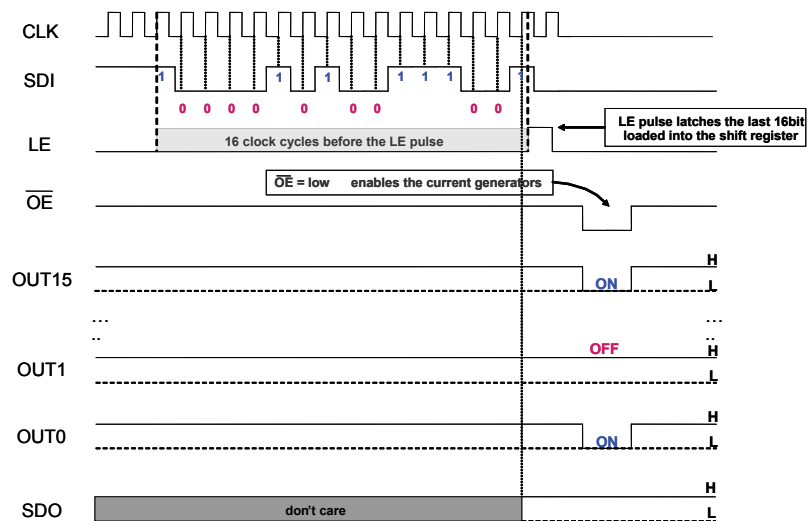
GIPD180420160821MT

8 Timing diagrams

The timing diagram shown in Figure 10 and the truth table in Table 6 explain how to send data to the device. This can be summarized in the following points:

- LE and \overline{OE} are level sensitive and not synchronized with the CLK signal
- When LE is at low level, the latch circuit holds previous data
- If LE is high level, data present in the shift register are latched
- When \overline{OE} is at low level, the status of the outputs OUT0 to OUT15 depends on the data in the latch circuits
- With \overline{OE} at high level, all outputs are switched off independently on the data stored in the latch circuits
- Every rising edge of the CLK signal, a new data on SDI pin is sampled. This data is loaded into the shift register, whereas a bit is shifted out from SDO

Figure 10. Timing diagram

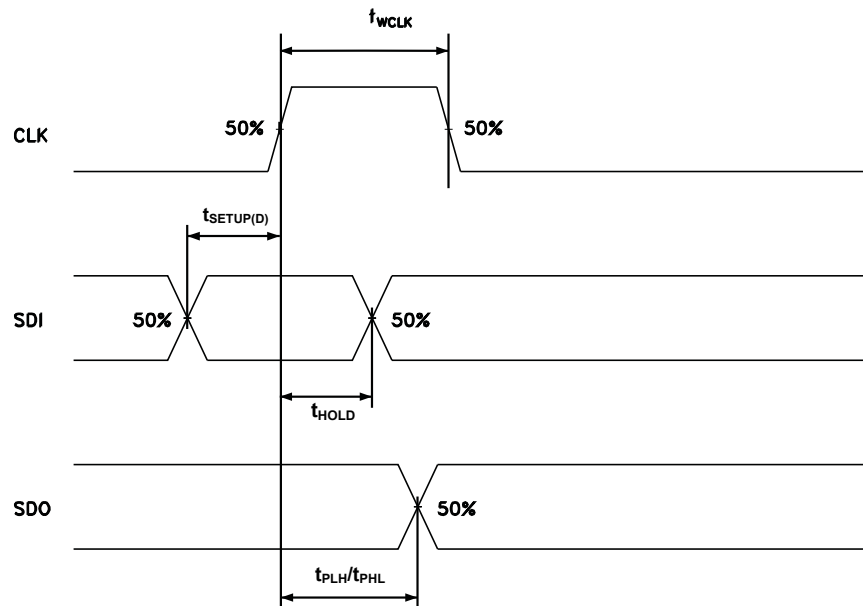


GIPD180420160825MT

Table 6. Truth table

Clock	LE	\overline{OE}	Serial-IN	OUT0 OUT7 OUT15 ⁽¹⁾	SDO
	H	L	Dn	Dn Dn - 7 Dn - 15	Dn - 15
	L	L	Dn + 1	No change	Dn - 14
	H	L	Dn + 2	Dn + 2 Dn - 5 Dn - 13	Dn - 13
	X	L	Dn + 3	Dn + 2 Dn - 5 Dn - 13	Dn - 13
	X	H	Dn + 3	OFF	Dn - 13

1. $OUTn = ON$ when $Dn = H$, $OUTn = OFF$ when $Dn = L$.

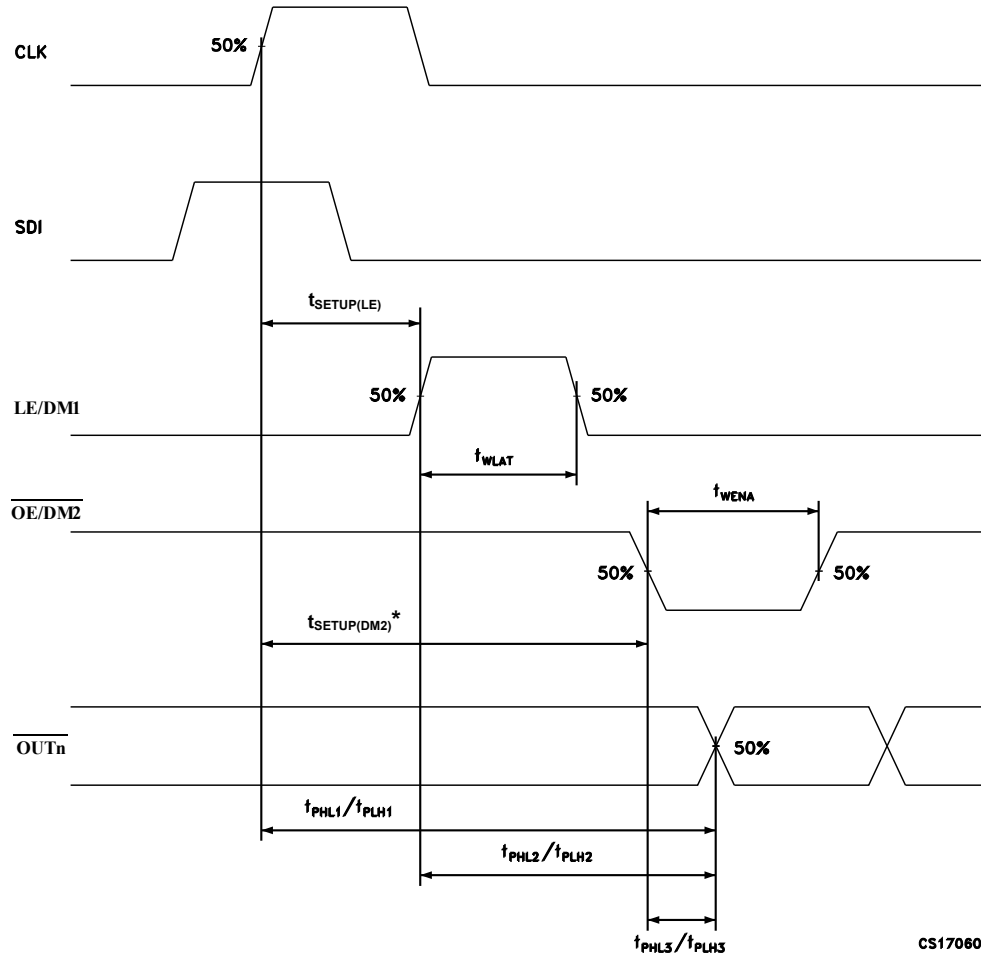
Figure 11. Timing for clock signal, serial-in and serial out data


AMG130220170701MT

The correct sampling of the data depends on the stability of the data at SDI on the rising edge of the clock signal and it is assured by a proper data setup and hold time ($t_{\text{SETUP}1}$ And t_{HOLD}), as shown in Figure 11. The same figure shows the propagation delay from CLK to SDO ($t_{\text{PLH}}/t_{\text{PHL}}$). Figure 12 describes the setup times for LE and $\overline{\text{OE}}$ signals ($t_{\text{SETUP}2}$ and $t_{\text{SETUP}3}$ respectively), the minimum duration of these signals (t_{WLAT} and t_{WENA} respectively) and the propagation delay from CLK to OUT_n , LE to OUT_n and $\overline{\text{OE}}$ to OUT_n ($t_{\text{PLH}1}/t_{\text{PHL}1}$, $t_{\text{PLH}2}/t_{\text{PHL}2}$ and $t_{\text{PLH}3}/t_{\text{PHL}3}$ respectively). Finally Figure 13 defines the turn-on and turn-off time (t_r and t_f) of the current generators.



Figure 12. Timing for clock signal serial-in data, latch enable, output enable and outputs

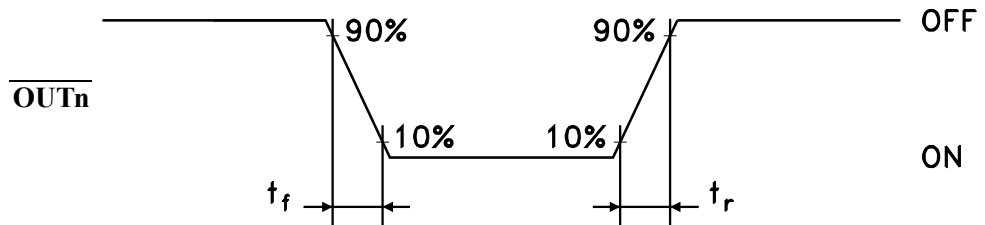


CS17060

* Only for detection feature.

AMG130220170702MT

Figure 13. Outputs



CS17070

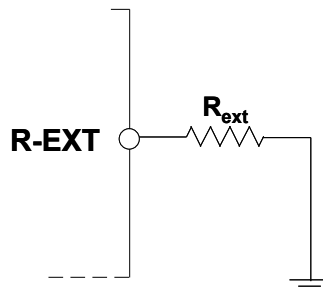
GIPD300920151146MT

9 Current generators characteristics

9.1 Current setting

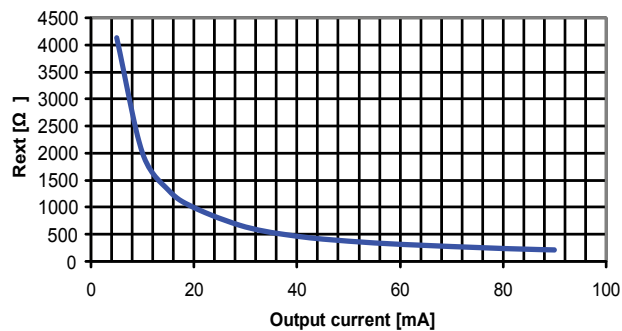
The current of all outputs is programmed through an external resistor connected to R-EXT pin, as shown in Figure 14. The curve in Figure 15 describes the relation between the current and the resistor connected to R-EXT pin, whereas the Table 7 shows how to set some typical current values.

Figure 14. Resistor for current programming



GIPD180420160836MT

Figure 15. Output current vs R-EXT resistor



GIPD180420160851MT

Table 7. Recommended values of R_{ext} for some output current value

Output current [mA]	R_{ext} [Ω]	Closer standard value (E24 series) [Ω]
5	4129	4300
10	2005	200
20	999	1000
40	471	470
60	322	330
90	217	220

9.2 Current accuracy

A typical current accuracy of $\pm 1\%$ ($\pm 3\%$ maximum) between channels is guaranteed at 22 mA and 55 mA output current (refer to Table 5) and $\pm 6\%$ (maximum) current accuracy between ICs.

9.3 Generators voltage drop

In order to correctly regulate the current, a minimum dropout voltage must be assured across the current generators.



Figure 16 and Table 8 provides just an indicative idea about the dropout voltage to assure over the current range. However it is recommended to use value of V_{DROD} slightly higher than those indicated in Figure 16 and Table 8.

Figure 16. Dropout voltage vs output current

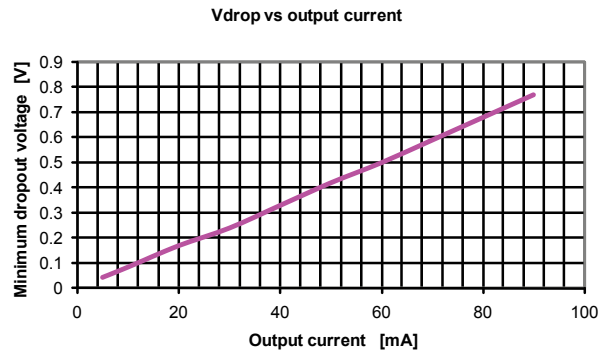


Table 8. Dropout voltage vs output current

Output current [mA]	V_{DROD} @ 3.3 V [mV]	V_{DROD} @ 5 V [mV]
5	44	44
10	85	85
20	170	170
40	350	330
60	530	500
90	820	770



10 Thermal shutdown

The STP16CPC26 is featured with a thermal shutdown. This protection is triggered if the junction temperature reaches 170 °C. When the thermal shutdown is activated, all outputs are turned off independently on the data latched. Once the temperature decreases (thermal shutdown hysteresis is typically 15 °C), the outputs are enabled again and the device keeps on working.

Once the temperature decreases (thermal shutdown hysteresis is typically 15°C), the outputs are enabled again and the device keeps on working.



11 Package information

In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.



11.1 QSOP-24 package information

Figure 17. QSOP-24 package outline

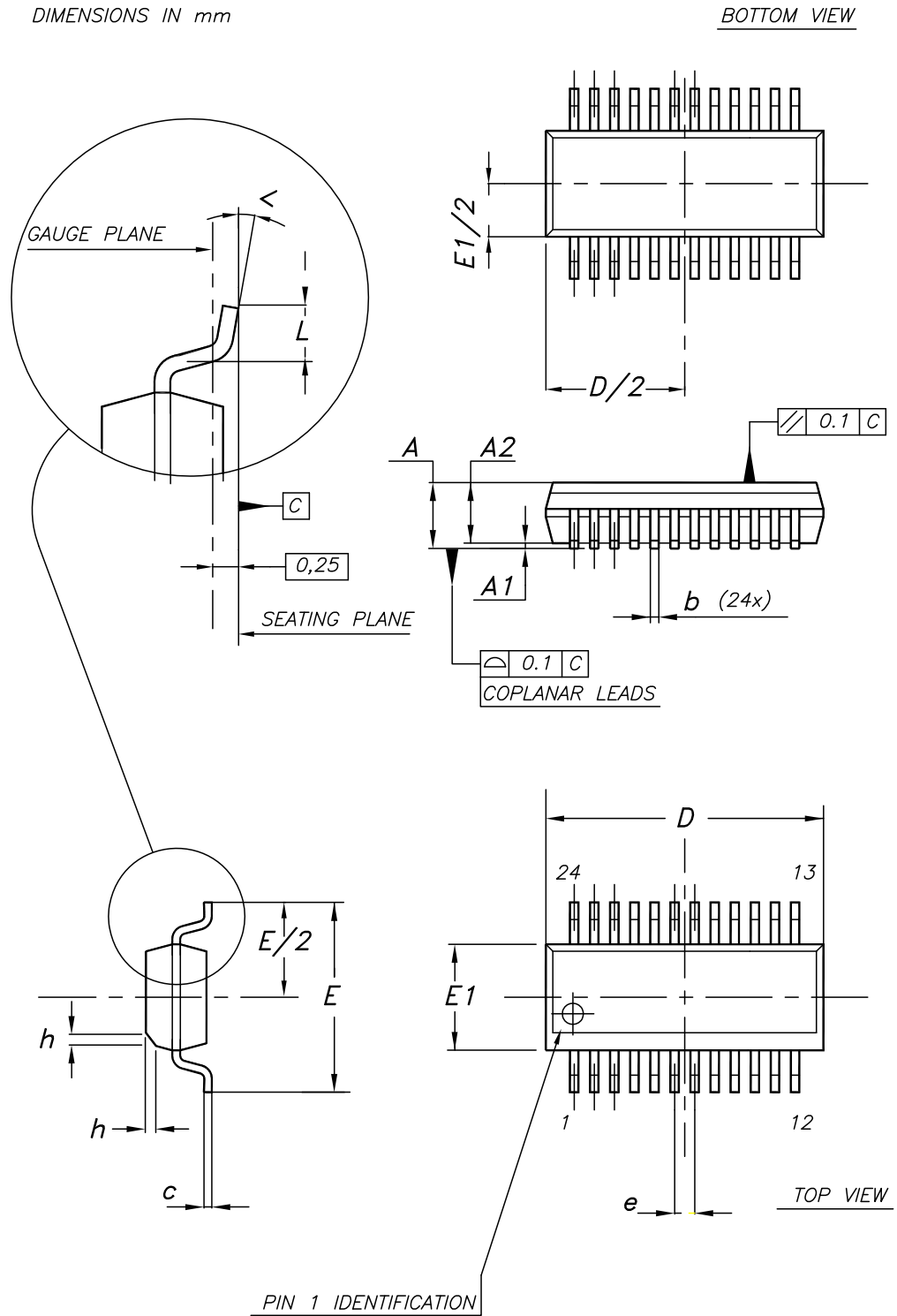


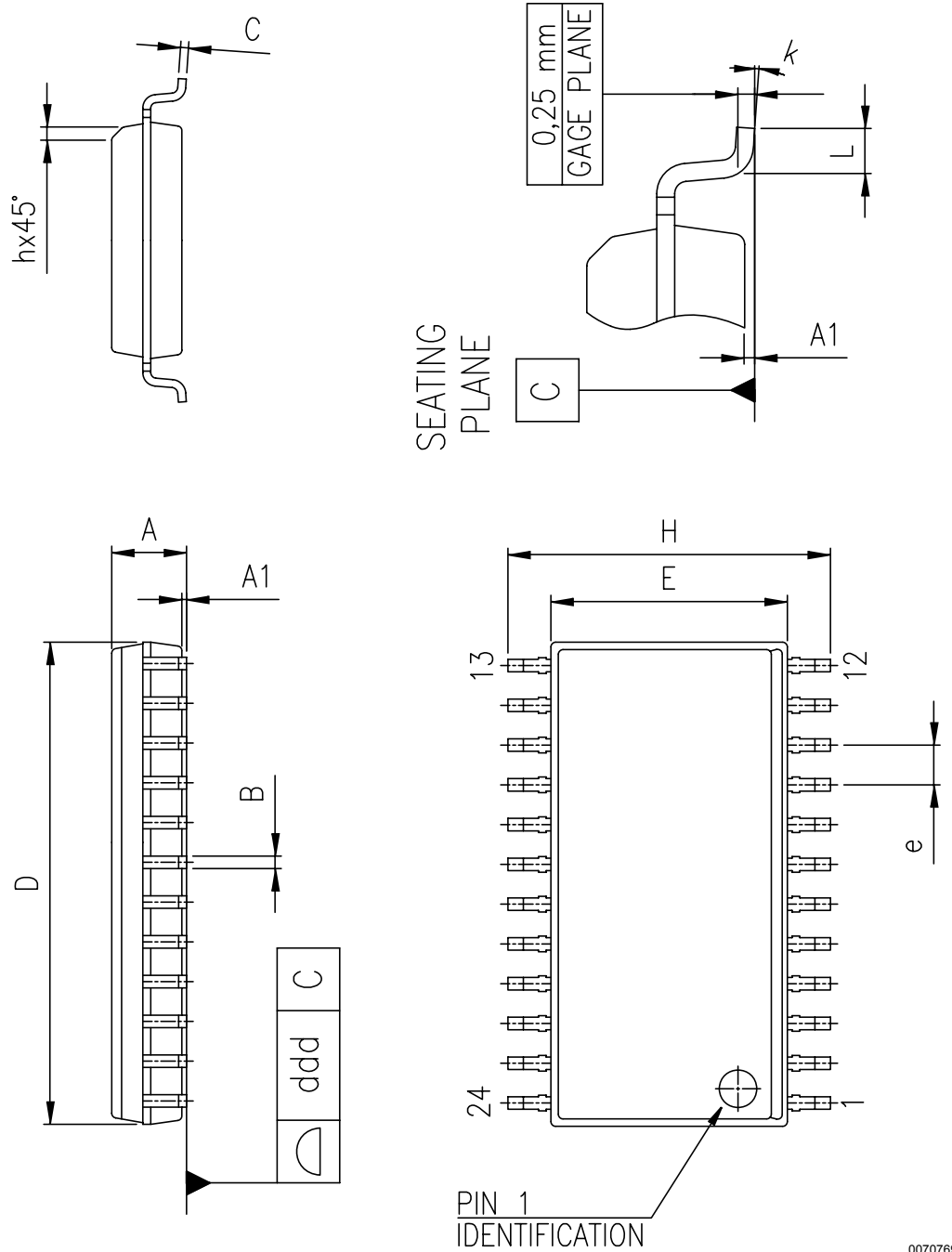

Table 9. QSOP-24 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	1.54	1.62	1.73
A1	0.10	0.15	0.25
A2		1.47	
b	0.20		0.31
c	0.17		0.254
D	8.56	8.66	8.76
E	5.80	6.00	6.20
E1	3.80	3.91	4.01
e		0.635	
L	0.40	0.635	0.89
h	0.25	0.33	0.41
<	0°		8°



11.2 SO-24 0070769 package information

Figure 18. SO-24 package outline

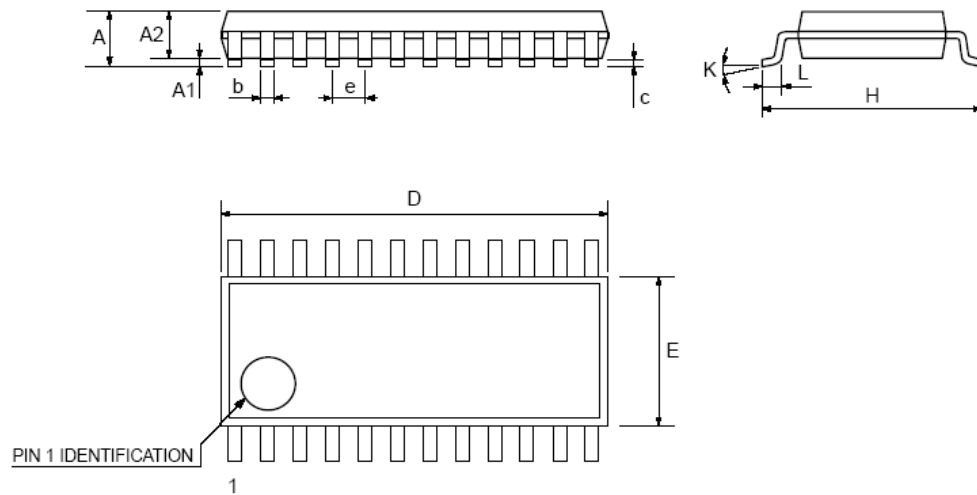


0070769

Table 10. SO-24 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.35		2.65
A1	0.10		0.30
B	0.33		0.51
C	0.23		0.32
D	15.20		15.60
E	7.40		7.60
e		1.27	
H	10.00		10.65
h	0.25		0.75
L	0.40		1.27
k	0		8
ddd			0.10

11.3 TSSOP24 package information

Figure 19. TSSOP24 package outline


7047476B


Table 11. TSSOP24 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			1.1
A1	0.05		0.15
A2		0.9	
b	0.19		0.30
c	0.09		0.20
D	7.7		7.9
E	4.3		4.5
e		0.65 BSC	
H	6.25		6.5
K	0°		8°
L	0.50		0.70



11.4 TSSOP24 exposed pad package information

Figure 20. TSSOP24 exposed pad package outline

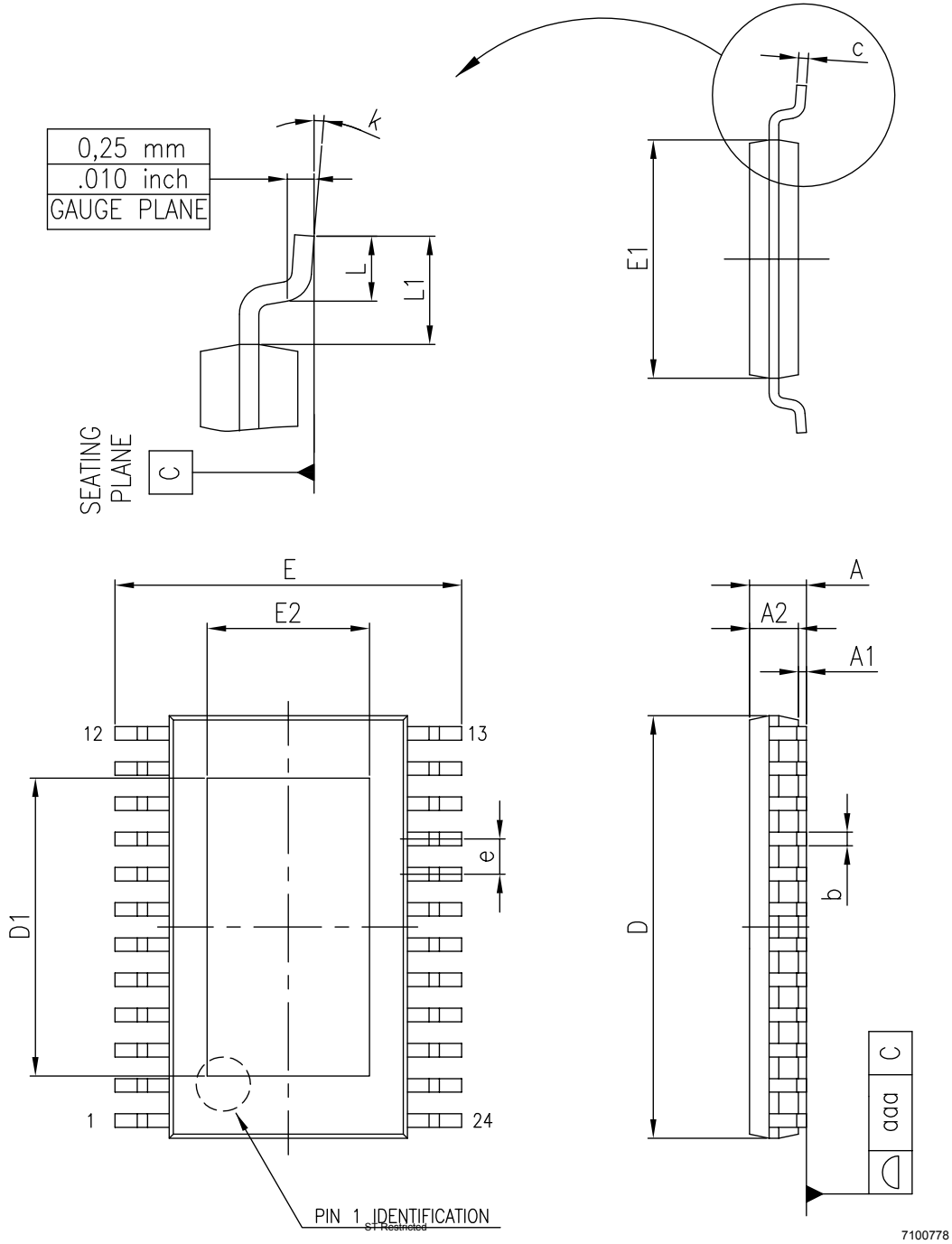




Table 12. TSSOP24 exposed pad mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			1.20
A1			0.15
A2	0.80	1.00	1.05
b	0.19		0.30
c	0.09		0.20
D	7.70	7.80	7.90
D1	4.80	5.00	5.20
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
E2	3.00	3.20	3.40
e			
L	0.45	0.60	0.75
L1		1.00	
K	0		8
aaa			0.10



11.5 TSSOP24, TSSOP24 exposed pad and SO-24 packing information

Figure 21. TSSOP24, TSSOP24 exposed pad and SO-24 reel outline

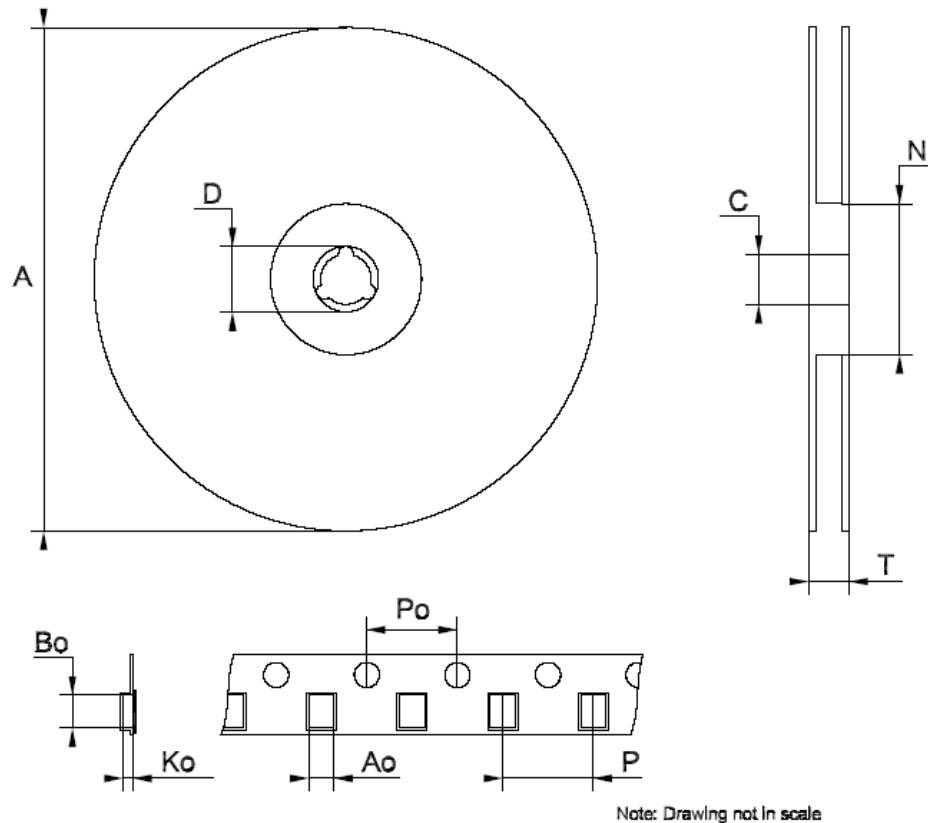


Table 13. TSSOP24 and TSSOP24 exposed pad tape and reel mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	330	-	331
C	13	-	14
D	18.7	-	
N	100	-	
T	16.5	-	18.5
Ao	6.85	-	7.05
Bo	8.2	-	8.4
Ko	1.5	-	1.7
Po	3.9	-	4.1
P	7.9	-	8.1



Table 14. SO-24 tape and reel mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A		-	330
C	12.8	-	13.2
D	20.2	-	
N	60	-	
T		-	30.4
Ao	10.8	-	11.0
Bo	15.7	-	15.9
Ko	2.9	-	3.1
Po	3.9	-	4.1
P	11.9	-	12.1



Revision history

Table 15. Document revision history

Date	Revision	Changes
04-Mar-2011	1	First release
05-Apr-2011	2	Updated Table 6
19-Jul-2012	3	Updated Table 7.
19-Jul-2012	4	Updated characteristics in Table 5: Electrical characteristics and Table 6: Switching characteristics. Minor text changes.
1-Jun-2014	5	Updated template and value Table 13: TSSOP24 exposed pad mechanical data.
13-Apr-2017	6	Updated Figure 11: "Timing for clock signal, serial-in and serial out data" and Figure 12: "Timing for clock signal serial-in data, latch enable, output enable and outputs", Section 11.1: "QSOP-24 package information". Minor text changes.
26-Jun-2023	7	Updated Table 1.



Contents

1	Pin description	2
2	Electrical ratings	3
2.1	Absolute maximum ratings	3
2.2	Thermal data	3
3	Electrical characteristics	4
4	Simplified internal block diagram	6
5	Typical application circuit	7
6	Equivalent circuit of inputs and outputs	8
7	Typical test circuits	10
8	Timing diagrams	11
9	Current generators characteristics	14
9.1	Current setting	14
9.2	Current accuracy	14
9.3	Generators voltage drop	14
10	Thermal shutdown	16
11	Package information	17
11.1	QSOP-24 package information	18
11.2	SO-24 0070769 package information	20
11.3	TSSOP24 package information	21
11.4	TSSOP24 exposed pad package information	23
11.5	TSSOP24, TSSOP24 exposed pad and SO-24 packing information	25
	Revision history	27



List of tables

Table 1.	Pin description	2
Table 2.	Absolute maximum ratings	3
Table 3.	Thermal data	3
Table 4.	Electrical characteristics	4
Table 5.	Switching characteristics	5
Table 6.	Truth table	11
Table 7.	Recommended values of R_{ext} for some output current value	14
Table 8.	Dropout voltage vs output current	15
Table 9.	QSOP-24 mechanical data	19
Table 10.	SO-24 mechanical data	21
Table 11.	TSSOP24 mechanical data	22
Table 12.	TSSOP24 exposed pad mechanical data	24
Table 13.	TSSOP24 and TSSOP24 exposed pad tape and reel mechanical data	25
Table 14.	SO-24 tape and reel mechanical data	26
Table 15.	Document revision history	27



List of figures

Figure 1.	Pin connection	2
Figure 2.	STP16CPC26 simplified block diagram	6
Figure 3.	Typical application circuit	7
Figure 4.	OE terminal	8
Figure 5.	LE terminal	8
Figure 6.	CLK, SDI terminal	8
Figure 7.	SDO terminal	9
Figure 8.	Typical test circuit for electrical characteristics	10
Figure 9.	Typical test circuit for switching characteristics	10
Figure 10.	Timing diagram	11
Figure 11.	Timing for clock signal, serial-in and serial out data	12
Figure 12.	Timing for clock signal serial-in data, latch enable, output enable and outputs	13
Figure 13.	Outputs	13
Figure 14.	Resistor for current programming	14
Figure 15.	Output current vs R-EXT resistor	14
Figure 16.	Dropout voltage vs output current	15
Figure 17.	QSOP-24 package outline	18
Figure 18.	SO-24 package outline	20
Figure 19.	TSSOP24 package outline	21
Figure 20.	TSSOP24 exposed pad package outline	23
Figure 21.	TSSOP24, TSSOP24 exposed pad and SO-24 reel outline	25

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