Product Bulletin

Document #:PB25648Z
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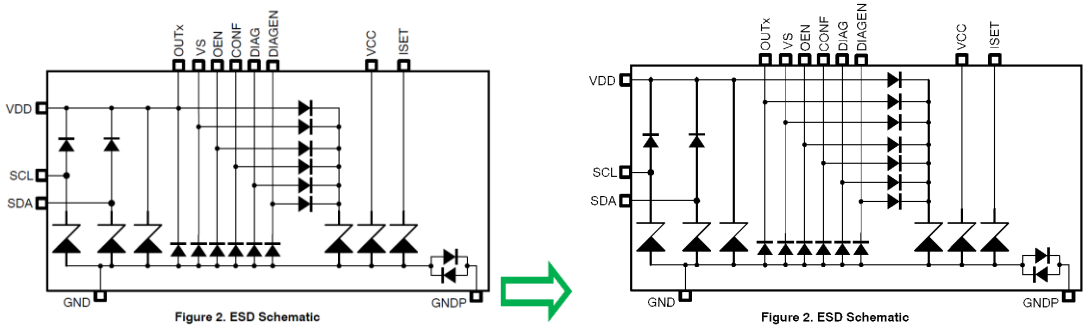
Title of Change:	Enhanced and more detailed description of the NCV7685 behavior inside of the datasheet. Highlight of important parameters for correct startup.
Effective date:	08 Aug 2023
Contact information:	Contact your local onsemi Sales Office or Ladislav.Bazant@onsemi.com
Type of notification:	This Product Bulletin is for notification purposes only. onsemi will proceed with implementation of this change upon publication of this Product Bulletin.
Change Category:	Datasheet change
Change Sub-Category(s):	Datasheet/Product Doc change

Sites Affected:

onsemi Sites	**External Foundry/Subcon Sites**
None	None

Description and Purpose:

- **ESD schematic picture "Figure 2. ESD Schematic"**
  - Typo in OUTx net which is shorted to VDD
  - Correction in rev.3



- **Adding supporting text to the Application Diagram for Figure 4.**
  - Text describes how to start up the NCV7685 device in the I2C mode
  - New text below the Figure 4.

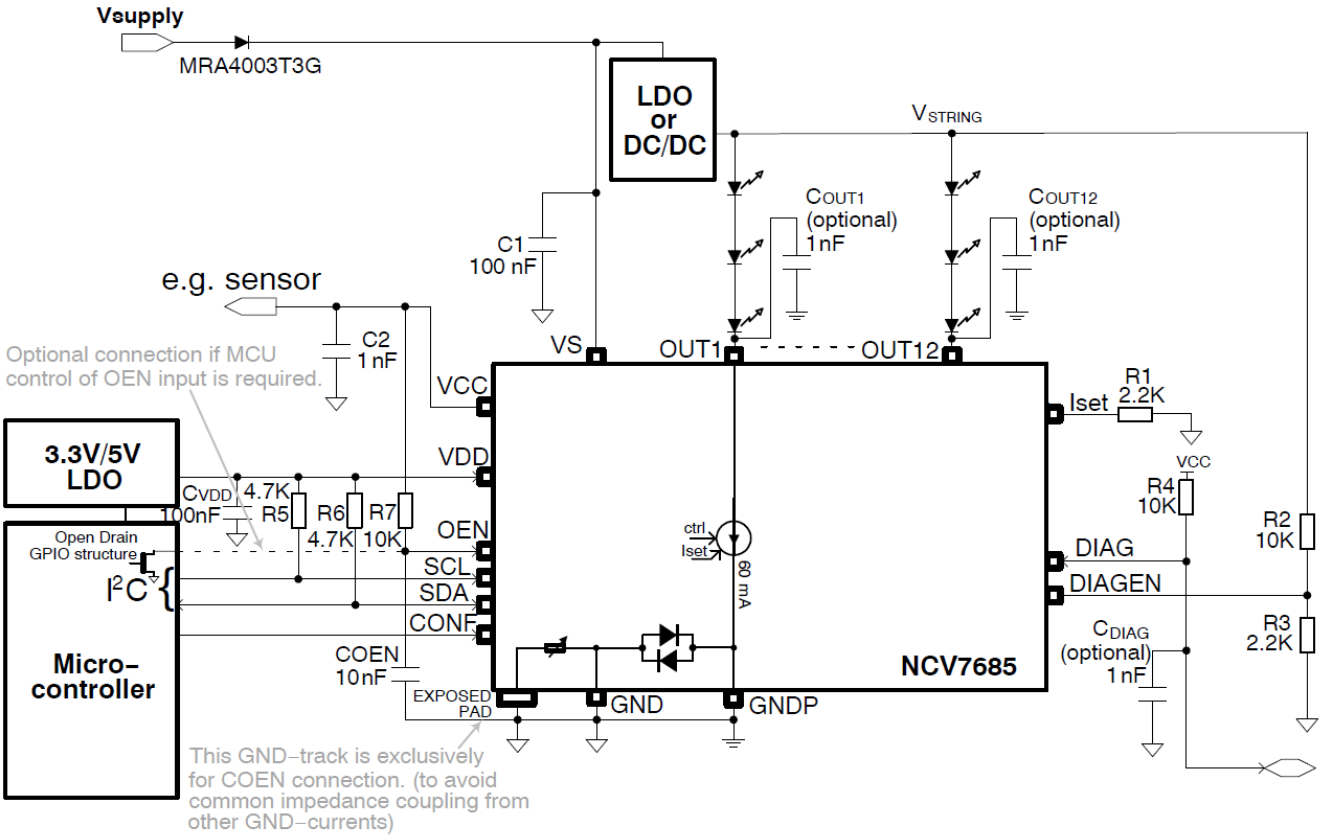


Figure 4. Application Diagram with Micro−controller (I^2C Mode)

The device is powered−up with both VS and VDD. Both must be in the recommended operating range.
− At power−up, the device loads the selected SAM register. (like in Stand Alone Mode)
− Because VDD is supplied, communication through the I^2C lines (SCL−and SDA−pins) is allowed
− I^2C mode must be activated by setting I2CFLAG in the I2C_CONF register.
NOTE: The NCV7685 may not start−up when VDD is kept between 1 V and VDDUV_R (2.9V)

- **Adding supporting text to the Application Diagram for Figure 5.**
  - Text describes how to start up the NCV7685 device in the standalone mode
  - New text below Figure 5.

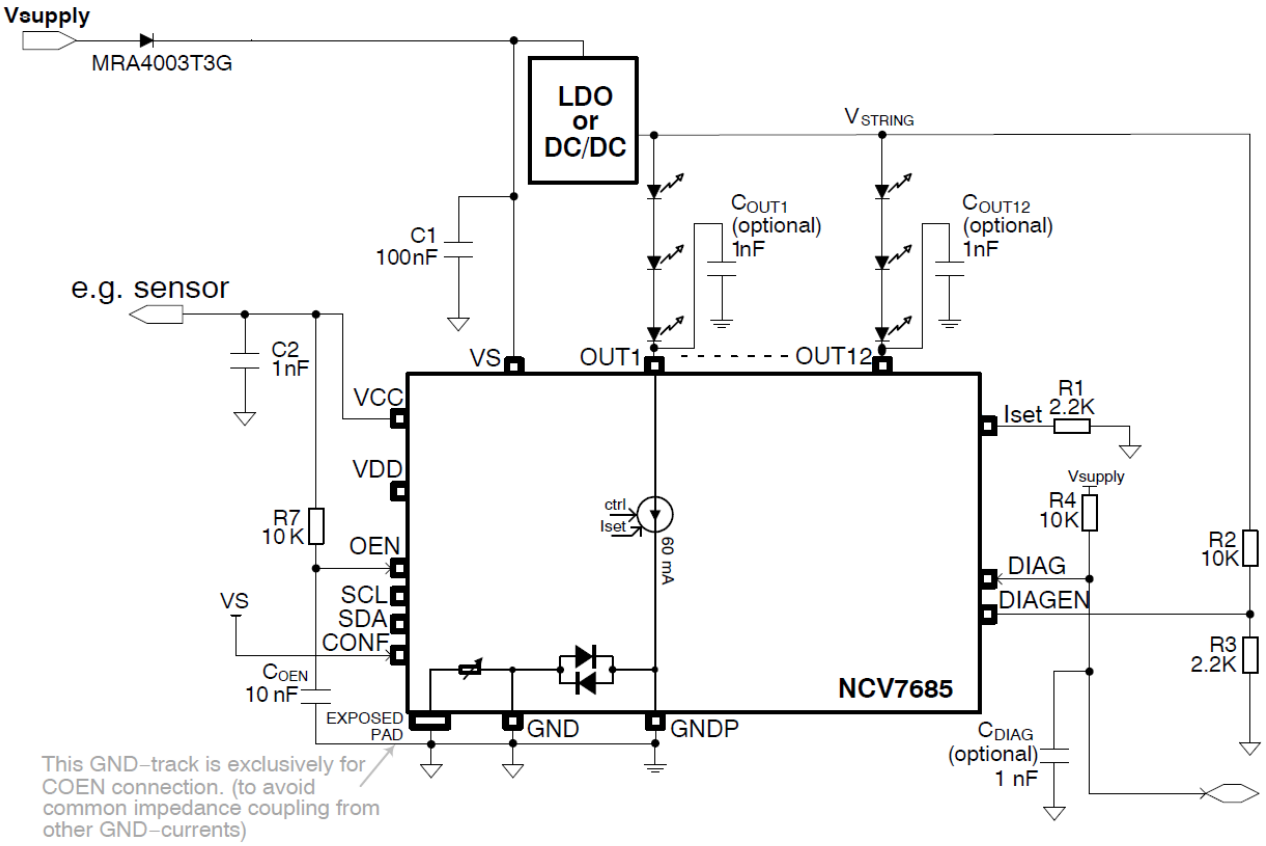


Figure 5. Application Diagram without Micro−controller (Stand Alone Mode)

The device is powered−up with only VS in the recommended operating range while VDD input is open or VDD is connected to GND.
− At power−up, the device loads the selected SAM register.
− Because VDD is not supplied, communication through the I2C lines (SCL−and SDA−pins) is not allowed.
− The I2C pins (SCL−and SDA−pins) must be left NC or connected to GND as those pins are internally protected via internal diodes to VDD−pin (See Figure 2)
NOTE: The NCV7685 may not start−up when VDD is kept between 1 V and VDDUV_R (2.9 V).

- **Merging the data from attributes table to the Absolute Maximum Ratings table**
  - To have datasheet according to the latest recommended template
  - Attributes table is removed
  - ESD parameters, MSL and storage temperature parameters from attributes table are moved to absmax**.**

Table 2. ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min	Max	Unit
V_{MAX_VS}	Power supply voltage: Continuous supply voltage Transient Voltage (t < 500 ms, "load dump")	 −0.3 −0.3	 28 40	 V V
V_{MAX_INx}	Input pin voltage (DIAGEN, DIAG, CONF, OEN)	−0.3	40	V
V_{MAX_OUTx}	Continuous Output Pin voltage Transient Voltage (t < 500 ms, "load dump") or during PWM period = OFF	−0.3 −0.3	28 40	V V
V_{MAX_VCC}	Stabilized supply voltage	−0.3	3.6	V
V_{MAX_VDD}	Digital input supply voltage	−0.3	5.5	V
V_{MAX_IO}	DC voltage at pins (VDD, SCL, SDA)	−0.3	5.5	V
V_{MAX_ISET}	DC voltage at pin ISET	−0.3	3.6	V
I_{MAX_GNDP}	Maximum Ground Current	–	750	mA
T_{JMAX}	Junction Temperature, T_J	−40	150	°C
T_{A_ZAP}	OTP Zap Ambient Temperature	10	30	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
1. Integrated protection functions are designed to prevent IC destruction under fault conditions described in the datasheet. Fault conditions are considered as outside normal operating range. Protection functions are not designed for continuous repetitive operation.

Table 3. ATTRIBUTES

Parameter	Value	Unit
ESD Capability (Note 2) ESD Voltage, HBM (Human Body Model): (100 pF, 1500 Ω) – All pins – Output pins OUTx to GND ESD according to CDM (Charge Device Model) – All pins – Corner pins	 ±2 ±4 ±500 ±750	 kV kV V V

Parameter	Symbol	Min	Max	Unit
Power supply voltage: Continuous supply voltage Transient Voltage (t < 500 ms, "load dump")	 VMAX_VS	 -0.3 -0.3	 28 40	 V V
Input pin voltage (DIAGEN, DIAG, CONF, OEN)	VMAX_Inx	-0.3	40	V
Continuous Output Pin voltage Transient Voltage (t < 500 ms, "load dump")	VMAX_OUTx	-0.3 -0.3	28 40	V V
Stabilized supply voltage	VMAX_VCC	-0.3	3.6	V
Digital input supply voltage	VMAX_VDD	-0.3	5.5	V
DC voltage at pins (VDD, SCL, SDA)	VMAX_IO	-0.3	5.5	V
DC voltage at pin ISET	VMAX_ISET	-0.3	3.6	V
Maximum Ground Current	IMAX_GNDP	-	750	mA
ESD Capability (Note 2) ESD Voltage, HBM (Human Body Model); (100 pF, 1500 Ω) -All pins -Output Pins OUTx to GND ESD according to CDM (Charge Device Model) -All pins -Corner pins ESD according to MM (Machine Model) -All pins	 ESD_{HBM} ESD_{CDM} ESD_{MM}	 ±2 ±4 ±500 ±750 ±150	 	 kV kV V V V
Moisture sensitivity (SSOP24−EP) (Note 3)		MSL2		
Storage Temperature		-55 to 150		°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
1. Integrated protection functions are designed to prevent IC destruction under fault conditions described in the datasheet. Fault conditions are considered as outside normal operating range. Protection functions are not designed for continuous repetitive operation.
2. This device series incorporates ESD protection and is tested by the following methods:
   ESD HBM tested per AEC−Q100−002 (EIA/JESD22−A114)
   ESD CDM tested per EIA/JES D22/C101, Field Induced Charge Model
   ESD MM according to AEC−Q100
3. For additional information, see or download onsemi's Soldering and Mounting Techniques Reference Manual, SOLDERRM/D, and Application Note AND8003/D.

- **Adding new Table 3. Recommended Operating Ranges**
  - Moving all relevant parameters into this table
  - Operation supply conditions VS and VDD from electrical table.
  - Temperature parameters from Attributes
  - Introducing new VS_SLOPE parameter based on design characterisation.

Table 3. RECOMMENDED OPERATING RANGES

Operating ranges define the limits for functional operation and parametric characteristics of the device. A mission profile (Note 4) is a substantial part of the operation conditions; hence the Customer must contact onsemi in order to mutually agree in writing on the allowed missions profile(s) in the application.

Parameter	Symbol	Min	Max	Unit
Analog Supply Voltage (VS) − parametric operation	VMAX_VS	5	18	V
Analog Supply Voltage − functional extended operation (Note 5)	VS_EXT	5	28	V
Analog Supply Voltage − slope (Note 6)	VS_SLOPE	10	10000	V/ms
OEN pin voltage during first 10 µs until VCC is activated (Note 7)	OEN_start	0	5	mV
Digital Supply Voltage (VDD)	VDD	3.15	5.5	V
Ambient Temperature	T_A	-40	125	°C
OTP Zap Ambient Temperature	T_{A_ZAP}	10	30	°C
Parametric operating junction temperature range (Note 8)	T_{JP}	-40	150	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.
4. A mission profile describes the application specific conditions such as, but not limited to, the cumulative operating conditions over life time, the system power dissipation, the system's environmental conditions, the thermal design of the customer's system, the modes and application diagrams, in which the device is operated by the customer, etc. No more than 20 cumulated hours in life time above TJP.
5. The parametric characteristics of the circuit are not guaranteed outside the Parametric operating range.
6. Analog supply slopes should be kept within specified range while VS < 5 V in order to guarantee safe start−up. However, if there is a need to exceed this value, please contact onsemi in order to mutually agree on the application.
7. Max slope on OEN pin must be secured accordingly to OEN paragraph to guarantee safe startup.
8. The parametric characteristics of the circuit are not guaranteed outside the Parametric operating junction temperature range.

- **New Table 4. Thermal Characteristics**
  - Package thermal resistance parameters are moved to standalone Table 4. Thermal Characteristics
  - Attributes table is removed
  -

Table 3. ATTRIBUTES

Parameter	Value	Unit
ESD Capability (Note 2) ESD Voltage, HBM (Human Body Model); (100 pF, 1500 Ω) – All pins – Output pins OUTx to GND ESD according to CDM (Charge Device Model) – All pins – Corner pins ESD according to MM (Machine Mode) – All pins	 ±2 ±4 ±500 ±750 ±150	 kV kV V V V
Moisture sensitivity (SSOP24−EP) (Note 3)	MSL2	
Storage Temperature	−55 to 150	°C
Package Thermal Resistance (SSOP24−EP) (Note 4) – Junction to Ambient, $R_{\theta JA}$ – Junction to Board, $R_{\theta JB}$ – Junction to Case (Top), $R_{\theta JC}$	 45.8 8.8 10.1	 °C/W °C/W °C/W

Table 4. THERMAL CHARACTERISTICS

Parameter	Value	Unit
Package Thermal Resistance (SSOP24−EP) (Note 9)		
– Junction to Ambient, $R_{\theta JA}$	45.8	°C/W
– Junction to Board, $R_{\theta JB}$	8.8	°C/W
– Junction to Case (Top), $R_{\theta JC}$	10.1	°C/W

9. Values represent thermal resistances under natural convection are obtained in a simulation on a JEDEC−standard, 2S2P; High Effective Thermal Conductivity Test Board as specified in JESD51−7, in an environment described in JESD51−2a.

- **Adding supporting text about standalone mode**
  - To better clarify the standalone mode and how this mode can be activated
  - Three methods how to get into Standalone Mode

I2CFLAG: the I2CFLAG should be reset whenever standalone mode is entered. When I2CFLAG=1 and when VDD is high, the I2C mode is activated, in all other conditions the device is in Stand Alone Mode.

The NCV7685 is in I2C mode when I2CFLAG=1 and when VDD is in the operating range.
Standalone mode is activated by resetting the I2CFLAG, which can be done with one of the following methods:
-method 1: By writing "0" on the I2CFLAG-bit through I2C communication.
-method 2: By generating undervoltage on VDD (VDD < VDDUV_F) while VS remains in the operating range.
-method 3: By generating POR by switching off both VS and VDD supply and then power-on again.
-VS and VDD supply have reached their off-state when both have their capacitors discharged to below 1 V.

- **ELECTRICAL CHARACTERISTIC table changes**
  - Removing Supply Voltage VS_EXT and VS_OP as they are already in Recommended Operating Ranges table.
  - Enhancing the test condition for VDDUV_x adding: “while VS in operation range”

Table 4. ELECTRICAL CHARACTERISTICS
(5 V < VS < 18 V, 3.15 V < VDD < 5.5 V, R1 = 1.82 kΩ, −40°C ≤ T_J ≤ 150°C, unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
GENERAL						
Supply Voltage	VS_EXT	Functional extended range (limited temperature)	5	–	28	V
	VS_OP	Parametric operation	5	–	18	V
Supply Under−Voltage	VSUV	VS rising	3.8	4.1	4.4	V
Supply range during OTP zapping	VS_OTPzap	2.5 V ≤ ISET ≤ 3.3 V; VS current peak capability ≥ 70 mA	13	–	18	V
Supply Under−Voltage hysteresis	VSUVhys		–	200	–	mV
Supply Current (Vs)	Is(error mode)	all OUTx OFF except channel in open load SCL = SDA = 0				
		Iout_VCC = 0 mA	– –	1.2 2.2	1.5 2.5	mA mA
		Iout_VCC = 1 mA				
	Is(active)	Active Mode VS = 16 V, Vcc unloaded OUTx = 1 V, R1 = 2 kΩ	–	7	10	mA
Digital supply current	IDD	I^2C mode, VS = 12 V	–	0.24	2	mA
VDD Under Voltage detection	VDDUV_R	VDD rising	–	–	2.9	V
	VDDUV_F	VDD falling	2	–	–	V

Table 5. ELECTRICAL CHARACTERISTICS
(5 V < VS < 18 V, 3.15 V < VDD < 5.5 V, R1 = 1.82 kΩ, −40°C ≤ T_J ≤ 150°C, unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
GENERAL						
Supply Under−Voltage	VSUV	VS rising	3.8	4.1	4.4	V
Supply range during OTP zapping	VS_OTPzap	2.5 V ≤ ISET ≤ 3.3 V; VS current peak capability ≥ 70 mA	13	–	18	V
Supply Under−Voltage hysteresis	VSUVhys		–	200	–	mV
Supply Current (Vs)	Is(error mode)	all OUTx OFF except channel in open load SCL = SDA = 0				
		Iout_VCC = 0 mA	– –	1.2 2.2	1.5 2.5	mA mA
		Iout_VCC = 1 mA				
	Is(active)	Active Mode VS = 16 V, Vcc unloaded OUTx = 1 V, R1 = 2 kΩ	–	7	10	mA
Digital supply current	IDD	I^2C mode, VS = 12 V	–	0.24	2	mA
VDD Under Voltage detection	VDDUV_R	VDD rising , while VS in operation range	–	–	2.9	V
	VDDUV_F	VDD falling , while VS in operation range	2	–	–	V

The main goal of all changes is to better clarify the functionality of the existing device, the change will not impact form, fit, or function of product

List of Affected Standard Parts:

***Note**: Only the standard (off the shelf) part numbers are listed in the parts list. Any custom parts affected by this PCN are shown in the customer specific PCN addendum in the PCN email notification, or on the **PCN Customized Portal**.*

NCV7685DQR2G		