Triple 60mA Linear LED Controller

E522.84/85/86/87

Production Data - Jul 26, 2017

RoHS compliant

Features

- Three integrated Linear Current Drivers (3*60mA)
- Parallel Output Operation for up to 180mA
- Low Power Standby / Sleep Mode
- Operating Input Voltage Range 5V to 25V, max. 40V
- External Reference Voltage / Derating Supported
- Common PWM Dimming (All channels in parallel)
- Diagnostic Functionalities (LED Driver Open/Short, IR Config Open/Short, Junction Temperature, Supply Voltage)
- Diagnostic Bus to link ICs
- “Single Lamp Behaviour” implemented
- AEC-Q100 Qualification

Applications

- Automotive LED Lighting, Rear Lighting
- Turn Indicator Driver
- Low Current Interior Lighting
- Industrial LED Applications or simple RGB Drivers

Ordering Information

Ordering-No.:	$Temp_{Junc}$ Range	Package
E52284A80D	-40°C to +150°C	SOIC8EP
E52285A80D	-40°C to +150°C	SOIC8EP
E52286A80D	-40°C to +150°C	SOIC8EP
E52287A80D	-40°C to +150°C	SOIC8EP

General Description

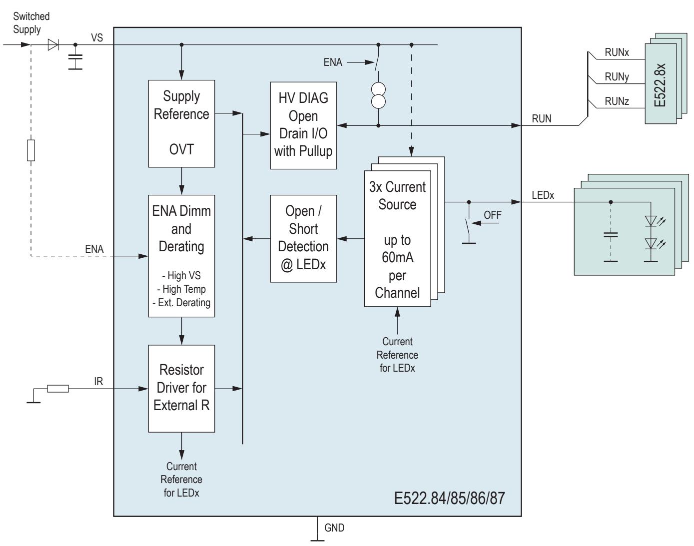
E522.84/85/86/87 family devices provide triple linear current controller for LED driving (standalone driver or LED cluster). Diagnostic features are provided to meet automotive requirements, together with a communication interface “RUN” to link ICs to generate more than three channels, supporting common current configuration per IC and including digital PWM dimming via fast ENA.

“Single Lamp Mode” allows to simulate the fail-behaviour of a single bulb to e.g. meet legal restrictions regarding lighting.

Internal derating for reference voltage and overtemperature shutdown for extreme temperatures >180°C protect E522.8x in case of abnormal operation conditions.

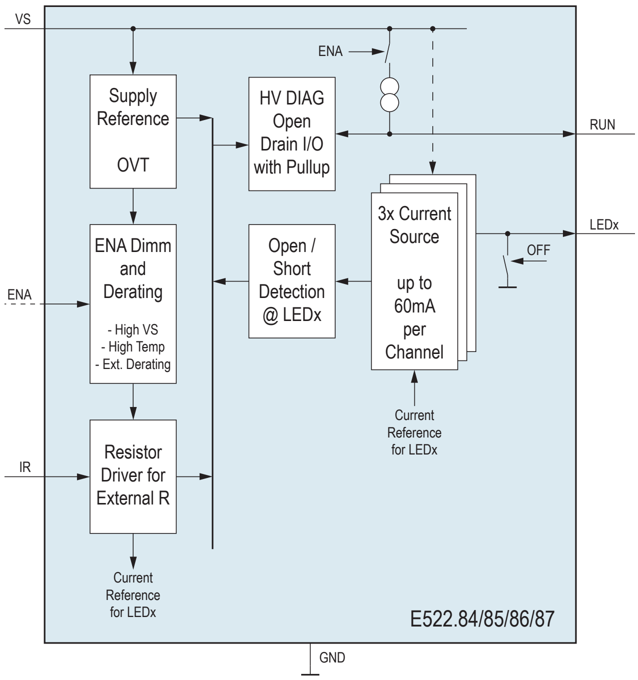
A high voltage capable input ENA can be used to digitally enable or disable E522.8x. In addition, this input may be used as analog reference voltage input, e.g. to realize thermal derating.

Typical Application Circuit



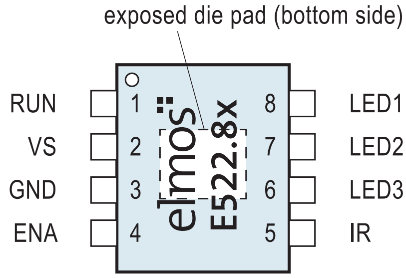
Version	'OPEN' Diagnostic	Package & Current
E522.84	Open Diagnostic at V_{VS} > 7.5V	SOIC8EP I_{LED} = 20mA...60mA
E522.85	Open Diagnostic at V_{VS} > 9.0V	SOIC8EP I_{LED} = 20mA...60mA
E522.86	Open Diagnostic at V_{VS} > 10.0V	SOIC8EP I_{LED} = 20mA...60mA
E522.87	Open Diagnostic at V_{VS} > 15.0V	SOIC8EP I_{LED} = 20mA...60mA

Functional Diagram



Pin Configuration

Top View



Note: *Not to scale*

Pin Description

Pin	Name	Type [1)]	Description
1	RUN	HV_A_IO	RUN Diagnostic Bus Interface to link 522.8x Products
2	VS	HV_S	High-Voltage Supply Input
3	GND	S	Ground Connection
4	ENA	HV_A_I	High-Voltage Enable and optional analog Referencevoltage Input
5	IR	A_IO	Current Configuration Interface
6	LED3	HV_A_O	Output Channel 3, connect to LED directly
7	LED2	HV_A_O	Output Channel 2, connect to LED directly
8	LED1	HV_A_O	Output Channel 1, connect to LED directly
-	Exposed Pad		Exposed Pad, Connect to GND for thermal connection

1) A = Analog, D = Digital, S = Supply, I = Input, O = Output, B = Bidirectional, HV = High Voltage

1 Absolute Maximum Ratings

Stresses beyond these absolute maximum ratings listed below may cause permanent damage to the device. These are stress ratings only; operation of the device at these or any other conditions beyond those listed in the operational sections of this document is not implied. Exposure to absolute maximum rated conditions for extended periods may affect device reliability. All voltages referred to VGND. Currents flowing into terminals are positive, those drawn out of a terminal are negative.

No.	Description	Condition	Symbol	Min	Max	Unit
1	VS Pin Voltage		V_{VS}	-0.3	40	V
2	ENA Pin Voltage		V_{ENA}	-0.3	40	V
3	IR Pin Voltage		V_{IR}	-0.3	5.5	V
4	IR Pin Current		I_{IR}	-1	1	mA
5	LEDx Current		$I_{LED.x}$	-100	100	mA
6	LEDx Pin Voltage		$V_{LED,x}$	-1	V_{VS}	V
7	RUN Pin Voltage		V_{RUN}	-0.3	V_{VS}	V
8	RUN Pin Current		I_{RUN}	-5	5	mA
9	Junction Temperature	Continuous	T_J	-40	150	°C
10	Ambient Temperature	Info Parameter 1)	T_A	-40	125	°C
11	Storage Temperature	Unsoldered Device	T_{ST}	-40	125	°C
12	Power Dissipation		P_V		1.8	W
13	Thermal Resistance Junction to Exposed Die Pad		$R_{TH,J-C}$		8	K/W

1) consider maximum junction temperature and cooling measures to define ambient operating range

2 ESD

No.	Description	Condition	Symbol	Min	Max	Unit
1	ESD HBM Protection at all Pins	1)	$V_{ESD,HBM}$	-2	2	kV
2	ESD CDM Protection at Corner Pins	2)	$V_{ESD,CDM,1}$	-750	750	V
3	ESD CDM Protection at all other Pins	2)	$V_{ESD,CDM,2}$	-500	500	V

1) According to AEC-Q 100-002, Human Body Model, 1.5kΩ resistance, 100pF capacitance.

2) According to AEC-Q 100-011, Charged Device Model, pulse rise time (10% to 90%) <400ps, 1Ω resistance.

3 Recommended Operating Conditions

No.	Description	Condition	Symbol	Min	Typ	Max	Unit
1	Recommended Operating Voltage Range		$V_{VS,OP}$	5	14	25	V
2	VS Capacitance per E522.8x		$C_{VS,OP}$	220	330		nF
3	Nominal Value of Current Selection Resistor at IR to GND	LED Channel operating [1]	R_{IR}	9.53		30	kΩ
4	Capacitance at IR Pin to drive R_{IR}		C_{IR}			100	pF
5	Typ. configured Operating Current per Channel	[1]	$I_{LED,x}$	19		60.5	mA
6	Dimming Frequency at ENA	[2]	f_{PWM}	50	200	1000	Hz
7	Minimum High / Low Pulsewidth in case of PWM Dimming		$T_{PULSE,PWM}$	90			µs
8	Total Capacitance for RUN Bus	[3]	C_{RUN}			1	nF
9	Capacitance at LEDx Driver Outputs		$C_{LED,x}$		6.8	22	nF
10	Inductance at LEDx Driver Outputs		$L_{LED,x}$			1	µH

1) If selection interface IR is used with higher resistive values take a reduced accuracy into account. Pay attention to the 'open' state detection limit „IIR,OPEN" for IRx configuration

2) High PWM frequencies need to take into account, that there is an inherent startup delay between rising edge at ENA and current flow, which may influence PWM linearity

3) High capacitance values lead to additional delay between rising edge at ENA and startup of LEDx Drivers

4 Electrical Characteristics

(V_{VS} = 5V to 25V, T_J= -40°C to +150°C and recommended operating range, unless otherwise noted. Typical values are at V_{VS} = 14V and T_J = 25°C. Positive currents flow into the device pins.)

4.1 Supply and Bias

Description	Condition	Symbol	Min	Typ	Max	Unit
Enable threshold at ENA	V_{ENA} rising	$V_{ENA,ON}$		1.2		V
Disable threshold at ENA	V_{ENA} falling	$V_{ENA,OFF}$		1.06		V
ENA internal Pulldown Resistor		$R_{ENA,PD}$		500		kΩ
VS Undervoltage Release Threshold	VS rising edge	$V_{VS,ERR}$	3.8	4.1	4.4	V
VS Undervoltage Hysteresis	VS falling edge	$V_{VS,ERR,HYST}$		440		mV
VS Sleepmode Current	V_{VS} = 14V V_{ENA} = 0V $T_J \leq$ +125°C	$I_{VS,SLEEP}$		12.5	28	µA
VS Current in "Standby Mode"	V_{ENA} > 3V V_{RUN} < 2V No error detected in device 1)	$I_{VS,STBY,NOM}$		80	140	µA
VS Standby Current in "Single Lamp Mode, Counting"	V_{ENA} > 3V “IR Open” error detected by device 2)	$I_{VS,STBY,ERR}$		100	150	µA
Device current consumption (GND pin current)	all channels regulation in saturation, no error detected R_{IR}=12kΩ	$I_{GND,OP}$		1.4	2.1	mA
Overtemperature Shutdown	T_J rising	$T_{J,OT}$	165	185		°C
Overtemperature Recovery Hysteresis *)	T_J falling	$T_{J,OT,HYST}$		20		°C
Initial Startup Delay of E552.8x after first Power-Up *)	Initial delay after V_{VS} > $V_{VS,ERR}$ V_{ENA} > $V_{ENA,ON}$	t_{START}		30	80	µs

**) Not tested in production*

1) See state diagram in chapter „5.4 State Diagram“ for details

*2) Please note, that in case of LED or IR shortcircuit the average input current also depends on the configured current and the re-diagnostic dutycycle. Example: In case of a single LED short to GND the current at VS in SLM is typ. approx. 100µA plus 64/5900*I_{LEDx}*

4.2 LED Driver

Description	Condition	Symbol	Min	Typ	Max	Unit
Current Amplification factor between IR Input and LEDx Outputs		$A_{I,LEDx/I,IR}$		385		
LED Current Tolerance (maximum)	R_{IR} = 9.53kOhm V_{VS} = V_{ENA} = 14V $V_{VS,LEDx}$ > 1V	$I_{LED,MAX}$	-64	-60.5	-57	mA
LED Current Tolerance (High)	R_{IR} = 12kOhm V_{VS} = V_{ENA} = 14V $V_{VS,LEDx}$ > 1V	$I_{LED,HIGH}$	-51	-48	-45	mA
LED Current Tolerance (Low)	R_{IR} = 30kOhm V_{VS} = V_{ENA} = 14V $V_{VS,LEDx}$ > 1V	$I_{LED,LOW}$	-21.5	-19	-16.5	mA
Drop-Voltage of LEDx Outputs for 50mA	I_{LEDx} = 50mA	$V_{LEDx,DROP}$		250	450	mV
Pulldown Resistor in case of LEDx being turned ‘off’	V_{VS} = 14V V_{ENA} = 0V	$R_{LED,PD,OFF}$		10		kΩ

4.3 IR Driver

Description	Condition	Symbol	Min	Typ	Max	Unit
Internal Nominal Reference to drive R_{IRx}	$V_{ENA} > 3.3V$ $T_J < T_{J,DERATE}$	$V_{REF,NOM}$	1.44	1.5	1.56	V
Internal Reference Derating in case of high V_{VS}	$V_{VS} > 29V$	$V_{REF,HV}$		0.9		V
Recommended Operating Range for External Reference at ENA [1]	Condition	$V_{REF,EXT}$	0.6		$V_{REF,NOM}$	V
Internal Divider Ratio between ENA and IR in case of external Reference Voltage	$1.2V < V_{ENA} < 3V$	$N_{ENA,DIV}$		2		
Internal Reference Derating Threshold for high V_{VS}	V_{VS} rising	$V_{VS,DERATE}$	25	27	29	V
Hysteresis for Voltage Derating Threshold	V_{VS} falling	$V_{VS,DERATE,HYST}$		1		V
Starting Junction Temperature for internal Reference Voltage Derating*)	$V_{ENA} > 3.3V$	$T_{J,DERATE}$	130	139	148	°C
Internal Reference Voltage Derating Slope*)	$V_{ENA} > 3.3V$ $T_J > T_{J,DERATE}$	$dV_{J,DERATE}$		-26.7		mV/K

**) Not tested in production*

1) Take 2:1 divider at ENA into account

4.4 RUN Interface and Diagnostics

Description	Condition	Symbol	Min	Typ	Max	Unit
RUN Pin Pullup Current to VS	$V_{VS} = 14V$ $V_{RUN} = 0V$	$I_{RUN,PU}$		-40		µA
RUN Bus Comparator, High Threshold		$V_{RUN,ENA}$	2.7	3	3.3	V
RUN Bus Comparator, Low Threshold		$V_{RUN,STBY}$	2.25	2.55	2.85	V
Hysteresis for RUN Thresholds	$V_{RUN,ENA} - V_{RUN,STBY}$	$V_{RUN,HYST}$	250	450		mV
RUN State Change Debouncing *)	Rising and falling edge	$t_{RUN,DEL}$		4		µs
RUN Low Level, Nominal	$V_{VS} = 14V$ $I_{RUN} = 2mA$	$V_{RUN,DRV1}$		0.2	0.8	V
RUN Low Level, low VS or VS Open	VS Pin 'open' $I_{RUN} = 2mA$ $T_J < 125°C$	$V_{RUN,DRV2}$		1.4	2	V
Current Limitation for RUN driving 'low'	$V_{RUN} = 5V$	$I_{RUN,LIM}$	10	22		mA
LEDx Short Circuit Detection Threshold	Relative to V_{GND}	$V_{LEDx,SHORT}$	0.9	1	1.1	V
Open Detection Threshold at LEDx, relative to nominal configured current	$R_{IRx} = 12k\Omega$ $V_{ENA} > 3V$ [1]	$I_{LEDx,OPEN}$	27.5	37.5	47.5	%
Open Diagnostic Enable Threshold at VS for E522.84	E522.84 [1] V_{VS} rising	$V_{VS,DIAG1}$	7.1	7.5	7.9	V
Open Diagnostic Enable Threshold at VS for E522.85	E522.85 [1] V_{VS} rising	$V_{VS,DIAG2}$	8.55	9.0	9.45	V
Open Diagnostic Enable Threshold at VS for E522.86	E522.86 [1] V_{VS} rising	$V_{VS,DIAG3}$	9.5	10	10.5	V
Open Diagnostic Enable Threshold at VS for E522.87	E522.87 [1] V_{VS} rising	$V_{VS,DIAG4}$	14.2	15	15.8	V
Open Diagnostic Enable Threshold at VS, Hysteresis	V_{VS} falling	$V_{VS,DIAG,HYST}$		0.5		V
IRx Pin Open Diagnostic Threshold	absolute current	$I_{IR,OPEN}$		9	18	µA
IRx Pin short circuit Diagnostic Threshold	absolute current	$I_{IR,SHORT}$	280	380		µA
Error Tolerance after Enabling a Channel	$V_{ENA} > V_{ENA,ON}$ $V_{IR} < V_{IR,DIS}$ [2]	$t_{ERR,DEB1}$		64		µs
Additional Debouncing Time in case of Error Detection during Operation*)	New Error detected	$t_{ERR,DEB2}$		4		µs
Re-Diagnosis time out in case of Error Detection	ERR present at E522.8x [3]	$t_{ERR,REDIAG}$	4.1	5.9	9.1	ms

**) Not tested in production*
1) threshold is related to nominal current generated at IRx input. This diagnosis is active for V_{VS} voltages higher than $V_{VS,DIAGx}$
2) start up of a channel is performed within this tolerance time window
3) re-diagnosis is performed on either this timebasis or with each rising edge at ENA

5 Functional Description

5.1 Overview

E522.84/85/86/87 family devices provide triple linear current controler for LED driving, which can optionally be operated in parallel for higher current requirements. These family members support common current configuration for all channels with a single resistor plus digital PWM dimming via fast ENA input.

Various diagnostic features are provided to meet automotive requirements, together with a communication interface named “RUN” to link ICs. If linked in this way, the ICs can be operated as a combined cluster of drivers, turning ‘on’ and ‘off’ in parallel (e.g. turning all drivers ‘off’ in case of hardware failures).

“Single Lamp Mode” operation is implemented to support legal requirements, e.g. regarding automotive lighting.

Typical exemplary application topologies are presented in „5.7 Exemplary Application Topologies“.
More information on the LEDx drivers can be found in „5.2 LED Driver“.
For more details on the configuration via IR interface see „5.3 IR Driver“.
A detailed overview of functional states is given in „5.4 State Diagram“.
Diagnostic features are described in „5.5 RUN Interface and Diagnostics“.
Dimensioning formulas are available in „5.8 Dimensioning Formulas and Power Calculation“

For more advanced features, see family members E522.80/81/82/83, which provide e.g.:
- more current per channel
- active failure feedback operation
- additional powermanagement /-distribution options
- independent current configuration per channel
- independent digital dimming for each channel

5.2 LED Driver

Highside drivers for LEDx provide the current configured by IR pin, reproducing the IIR with a typical amplification factor of 385:1.

The LEDx outputs are monitored for short-circuit condition to GND (undervoltage) and open condition (ILEDx smaller than relative threshold ILEDx,OPEN). IR configuration is monitored separately, see diagnostic chapter 5.5 for details.

For parallel operation, the total output amplification factor is 1155:1. Monitoring functions (e.g. ‘open’ detection) remain active per channel, thus a loss of a single LEDx output connection will be detected.

5.3 IR Driver

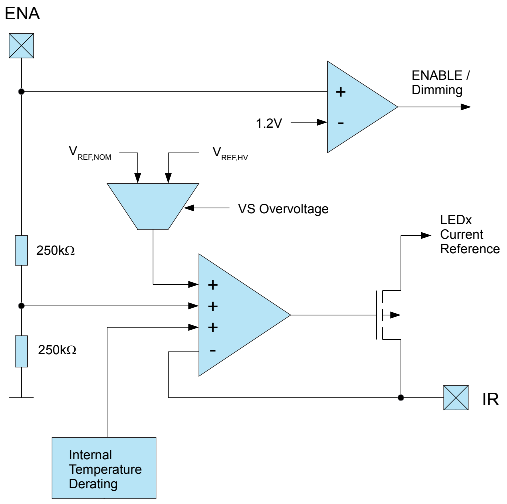


Figure 1. IR Reference Generation

The interface IR is used to configure the current for all LEDx channels. The current flow in IR is multiplied to LEDx by a factor of typical 385:1. Digital dimming can be used at ENA by applying V_{ENA} > 3V or V_{ENA} < 1V.

Various factors influence the reference voltage driven to IR as an output. Details are illustrated in „Figure 1. IR Reference Generation“.
In nominal case (typical junction temperature, V_{ENA} > 3V) the internal reference is used. The lowest reference applied to the amplifier shown in „Figure 1. IR Reference Generation“ is used to regulate VIR.

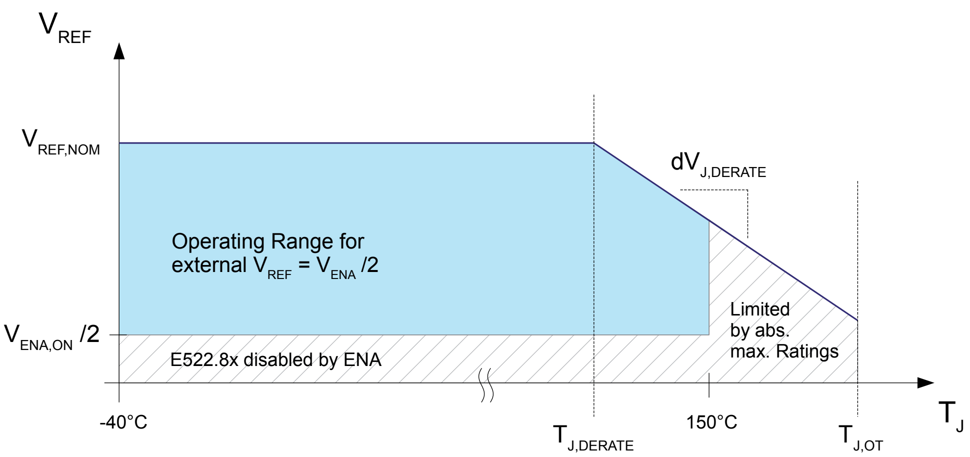


Figure 2. Principle of Internal Temperature Derating

The internal reference derating function implemented is rather tolerant to allow external configuration of derating by the user. It typically starts to derate the internal reference at T_J = 138°C, falling with typ. -26.7mV/K beyond this temperature. The range of operating E522.8x with external reference or external derating is shown in „Figure 2. Principle of Internal Temperature Derating“.

To realize an external derating function and shutdown, it is possible to use e.g. a temperature dependent resistor divider at ENA. In the range of typically 3V down to $V_{ENA,OFF}$ the voltage $V_{ENA}/2$ is used to drive V_{IR}. Falling below $V_{ENA,OFF}$ disables E522.8x, restarting with $V_{ENA,ON}$.

5.4 State Diagram

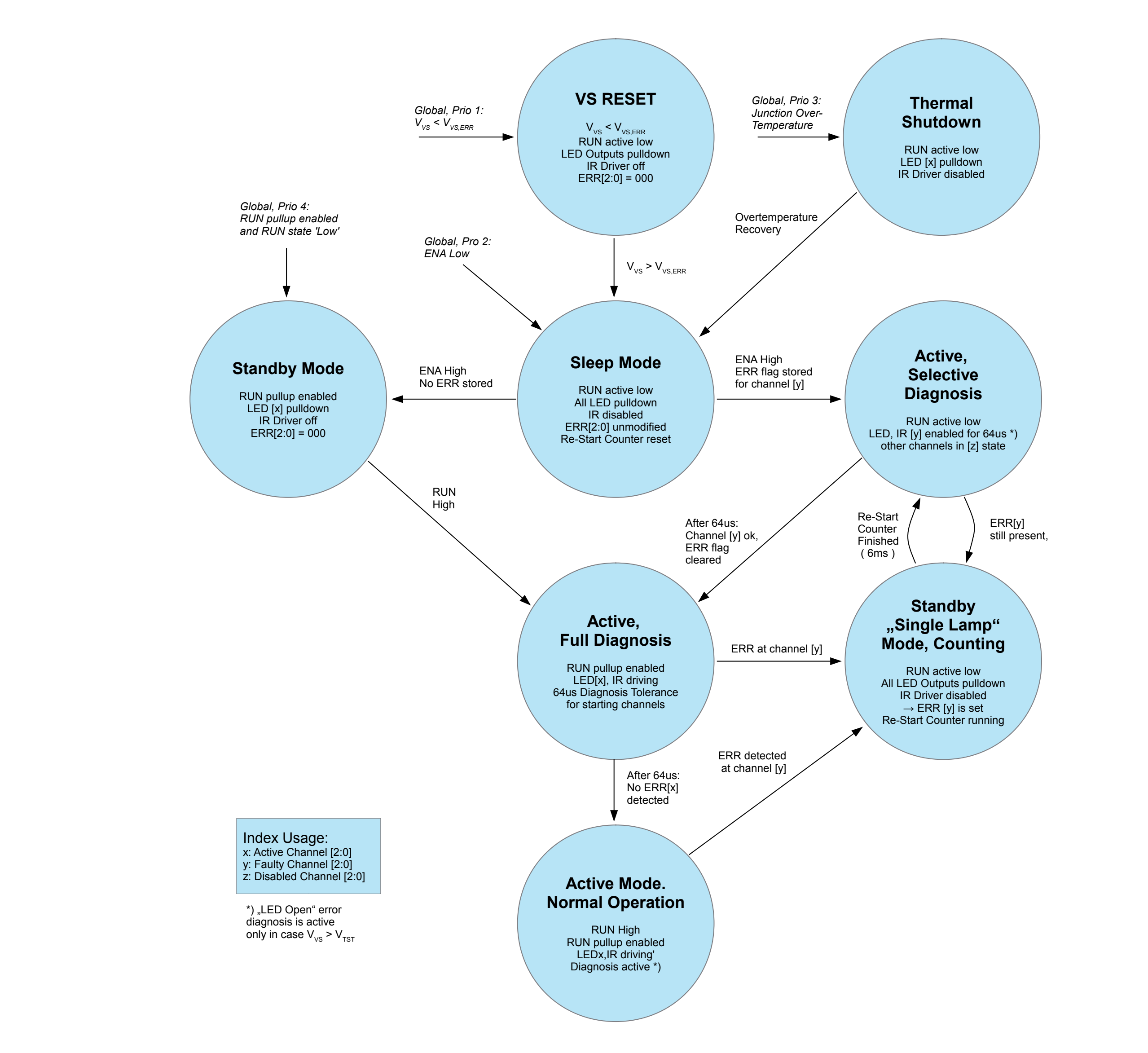


Figure 3. State Diagram E522.84/85/86/87

5.5 RUN Interface and Diagnostics

Diagnostic features provided in E522.8x include the monitoring of

- High impedant IR driver (e.g. in case of ‘open’ connection for the external configuration resistor)
- Short-circuit at IR driver to GND
- Short circuit of LEDx to GND for each channel (checking for a static threshold of $V_{LEDx,SHORT}$)
- Open LEDx connections for each channel. E522.8x family members provide different thresholds of V_{VS} to enable this monitor, thus avoiding wrong ‘OPEN’ error detection in case VVS is smaller than the forward voltage VLED of the LEDs
- Internal junction overtemperature (disabling all channels)
- V_{VS} voltage monitoring for undervoltage (providing defined behavior for slow supply ramping)

The LEDx driver ‘open’ detection is relative to the actual current configured at IRx. This detection is active if the supply V_{VS} is higher than $V_{VS,DIAGx}$, which is a family member specific threshold.

If a defect at any of the channels is detected, it is stored for selective re-diagnosis. Dimming at ENA does not delete this information. A diagnosis cycle showing removal of the erroneous conditions or VS undervoltage reset the stored flag to ‘0’.

Re-diagnosis in case of continuous operation is performed on a regular time-basis of $t_{ERR,REDIAG}$ to allow replacement of defect loads / LEDs for such applications.

A loss of VS connection for a single E522.8x is propagated via RUN being set to low, as well as for ENA being ‘low’ (e.g. in case of ‘OPEN’ failure at ENA).

5.6 Typical Performance Figures

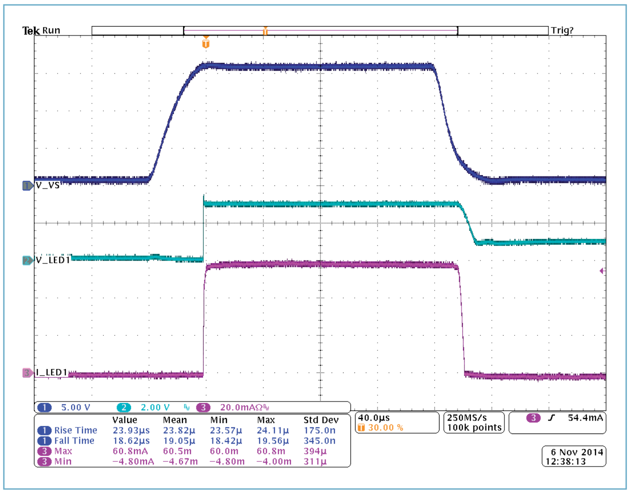


Figure 4. Fast Supply Step (Startup)

Typical Startup from unsupplied to 16V, Delay to deliver current is <40µs.
Dark-Blue: VS-Supply, Bright-Blue: LED voltage,
Purple: Current Probe for LED current

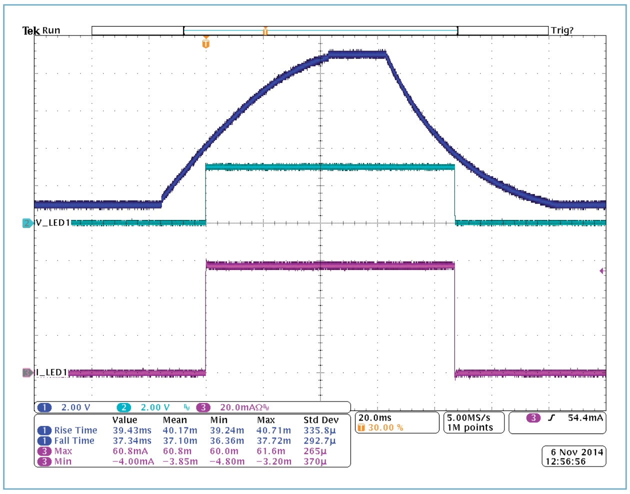


Figure 5. Slow Supply Ramping

Ramping of Supply in >20ms. Bright-blue channel shows the LED driver output, dark-blue is the supply voltage at VS. Purple Curve is the according current probed.

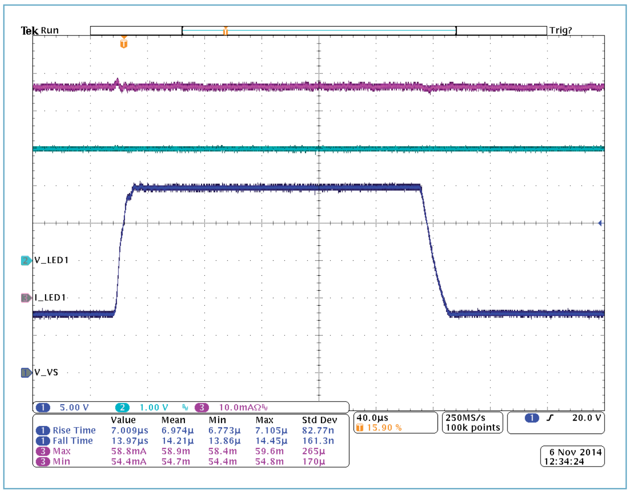


Figure 6. Very fast VS Stepresponse (8V to 25V)

Very steep rising and falling VS Supply,
8V to 25V at VS, Risetime approx. 14µs.
Purple Channel: LED Current
Bright-Blue Channel: LED Voltage
Dark-Blue Channel: VS Supply Voltage (Step)

5.7 Exemplary Application Topologies

This chapter provides various exemplary Application topologies and use-cases for E522.84/85/86/87. From basic setup to full automotive setup there are typical options given, which of course can be combined to more complex systems. Please make sure, that examples taken from this chapter fulfil your application requirements.

5.7.1 Basic Application Topology

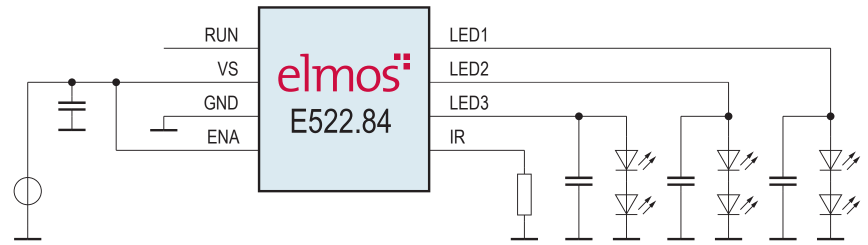


Figure 7. Basic Topology

This is an exemplary basic implementation using E522.84/85/86/87 Family members. The basic features are

- Permanent operation of all LED strings
- Common current configuration for all LED strings by single resistor
- Channels diagnostics are always active, switching all Outputs in common 'on' or 'off'
- Capacitors at the LED loads are used to improve PSRR of the circuit

5.7.2 Six Channel Cluster and Supply-Dimming

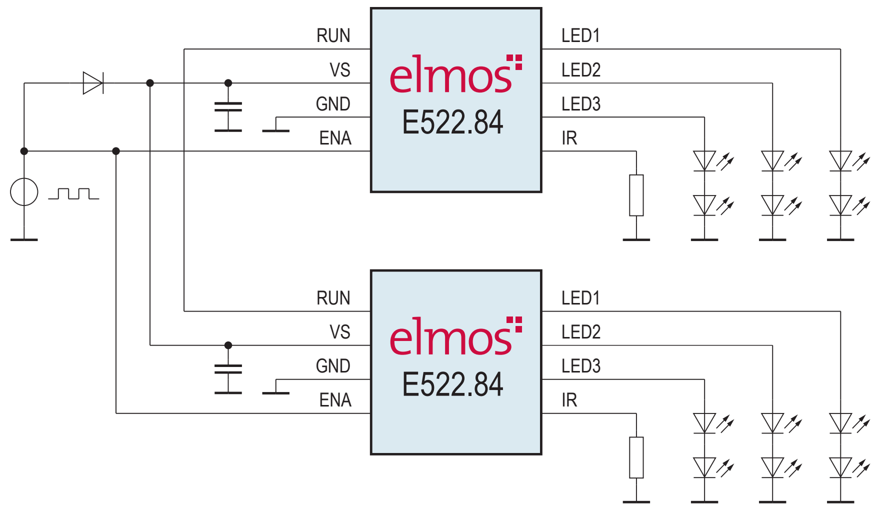


Figure 8. Six Channel Cluster

This Application is a six-channel cluster, that makes use of the following product features:

- - Digital Dimming via supply line is possible. ICs remain powered by reverse polarity protection and input capacitors, consuming only very low sleep mode currents during supply low phase
- - RUN connection is used to propagate a potential failure information between ICs, imitating the behaviour of a bulb if necessary (either all 'on' or all 'off')
- - Capacitors at LEDs are not drawn, but can improve e.g. power supply rejection ratio or ESD behaviour

5.7.3 Thermal Management and Parallel Operation

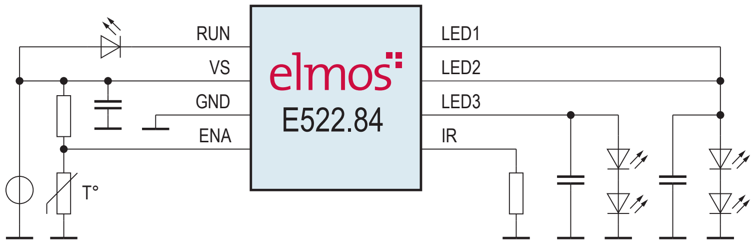


Figure 9. Thermal Application Topology

In this setup more thermal handling options are presented:

- Temperature depending divider at ENA provides derating, if the divided voltage falls below the internal reference of E522.8x
- Parallel operation of two channels to increase output current
- An optional fail-indicator LED is connected to RUN, which may be useful e.g. to identify defect PCBs. The build in current limitation of the RUN pin defines the current
- Capacitors parallel to loads improve PSRR and thus the lifetime of the LEDs in case of e.g. ESD events

5.7.4 Automotive Cluster Application

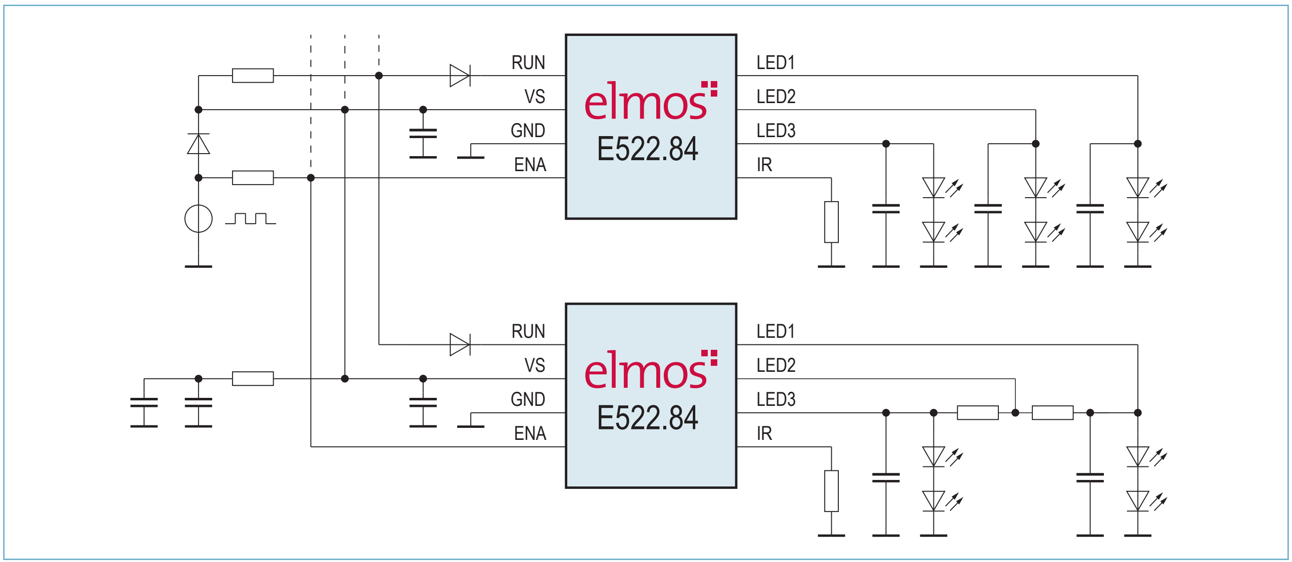


Figure 10. Automotive Cluster Application

The application shows additional elements, that are typically useful for an automotive environment. Further elements may be necessary (e.g. input protection or suppressor diodes as required).

Features of this setup are:

- Digital dimming via battery line, e.g. from control modules highside driver
- RUN diode-Or bus for failure indication, making use of central bus pullup resistor to VS (If the bus has no further connections than E522.8x ICs, it can be omitted. Just leave pins RUN open in this case)
- RUN bus configured as drawn: Only strings of a single IC will switch 'off' in case of a diagnostic event. If the diode is replaced by a direct connection, the complete cluster can be switched 'off'. The central pullup is not necessary in this case (hint: ENA 'low' leads to active low RUN)
- The lower IC in „Figure 10. Automotive Cluster Application" uses balancing resistors to equally share its current between Channel 1 and 3, thus less than three channels are possible with one IC. Alternatively, see Elmos datasheet E522.80 for a compatible IC with more sophisticated options to disable channels
- Various protective devices added for automotive environment, like e.g. damping R-C network for inductive supply line
- Topology can be extended by further devices of the E522.8x family to build larger clusters

5.8 Dimensioning Formulas and Power Calculation

Current Calculation

In this chapter initial dimensioning formulas for E522.84/85/86/87 applications are provided. The same current in all channels is derived from a single resistor at IR to GND.
Current per channel:

$$I_{LED,x} = \frac{A_{I,LEDx/I,IR} \cdot V_{IR}}{R_{IR}}$$

which can be re-written to

$$R_{IR} = \frac{A_{I,LEDx/I,IR} \cdot V_{IR}}{I_{LED,x}}$$

Typical values for calculations are $A_{I,LEDx/I,IR}$ = 385 and typ. $V_{IR,NOM}$ generated internally of 1.5V. (Details on reference generation can also be found in „Figure 1. IR Reference Generation“ of chapter „5.3 IR Driver“)
For operation with all three channels in parallel, the resistor at IR can be calculated by applying three times the single-channel gain (typ. 1155:1):

$$R_{IR} = \frac{3 \cdot A_{I,LEDx/I,IR} \cdot V_{IR}}{I_{LED,TOTAL}} = \frac{1155 \cdot V_{IR}}{I_{LED,TOTAL}}$$

Power Calculation

To calculate the power in E522.84/85/86/87 for a typical application, the load voltage $V_{LOAD,LEDx}$ must be taken into account per channel. The maximum static supply voltage level is assumed to be $V_{VS,MAX}$, input reverse-protection diode (e.g. in automotive environments) reduces the input voltage of E522.8x by it´s forward voltage drop ($V_{DIO,REV}$).

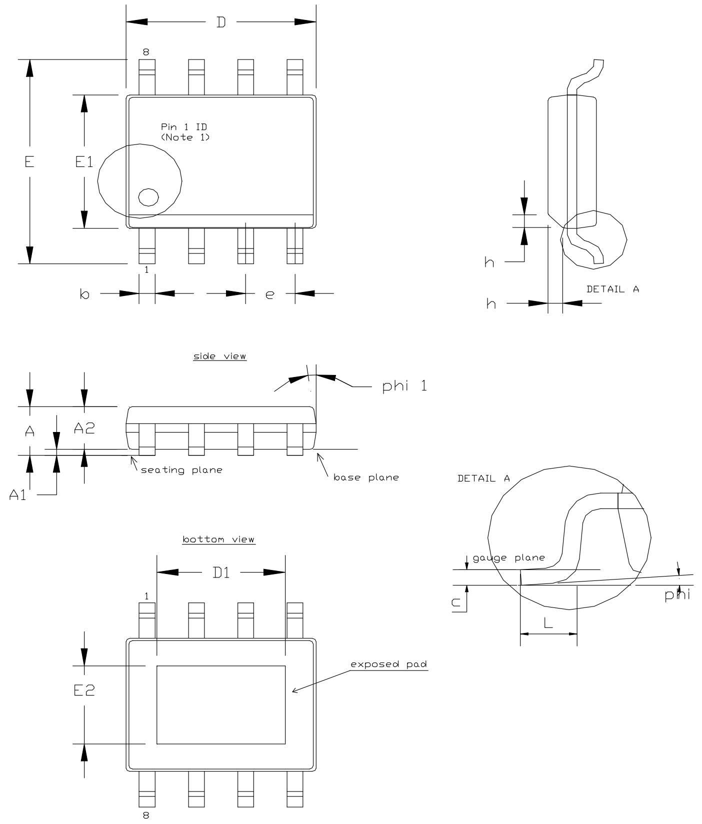
$$P_{E522.8x} = (V_{VS,MAX} - V_{DIO,REV}) \cdot \left(\sum I_{LEDx} + I_{GND,OP}\right) - \sum P_{LOAD}$$

$$\sum P_{LOAD} = I_{LED,x} \cdot (V_{LED1} + V_{LED2} + V_{LED3})$$

Please note:
All values for initial dimensioning derived in this chapter must be verified by suitable prototyping measures

6 Package Reference

All devices are available in a Pb free, RoHs compliant SOIC8N-EP plastic package according to JEDEC MS-012-F, variant BA. The package is classified to Moisture Sensitivity Level 3 (MSL 3) according to JEDEC J-STD-020 with a soldering peak temperature of (260+5)°C.



Symbol	mm		
	min	typ	max
A	--	--	1.70
A1	0.00	--	0.15
A2	1.25	--	--
b	0.31	--	0.51
c	0.10	--	0.25
D	4.90 BSC		
D1	3.30 BSC		
E	6.00 BSC		
E1	3.90 BSC		
E2	2.29 BSC		
e	1.27 BSC		
L	0.40	--	1.27
h	0.25	--	0.50
Θ [°]	0	--	8
Θ1 [°]	5	--	15
N	8		

Note 1: for assembler specific pin 1 identification please see QM-document 08SP0363.xx (Pin 1 Specification)

7 Functional Safety

The development of this product is based on a process according to an ISO/TS16949 certified quality management system. Functional safety requirements according to ISO 26262 have not been submitted to Elmos and therefore have not been considered for the development of this product.

8 Record of Revision

Chapter	Revision	Change and Reason for Change	Date	Released Elmos
-	.00	Initial revision	Jan 21, 2015	DHOE/ZOE
5.8	.01	New chapter	Jul 26, 2017	DHOE/ZOE
6	.01	Drawing dimensions table revised	Jul 26, 2017	DHOE/ZOE

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