EST327

OBD to RS232 Interpreter

Rev.1.5 — 3 Jan 2014   **Product data sheet**

1. Features

- Supports 12 protocols
- Automatically searches for a protocol
- Fully configurable with AT commands
- RS232 baud rates to 500Kbps
- Voltage input for battery monitoring
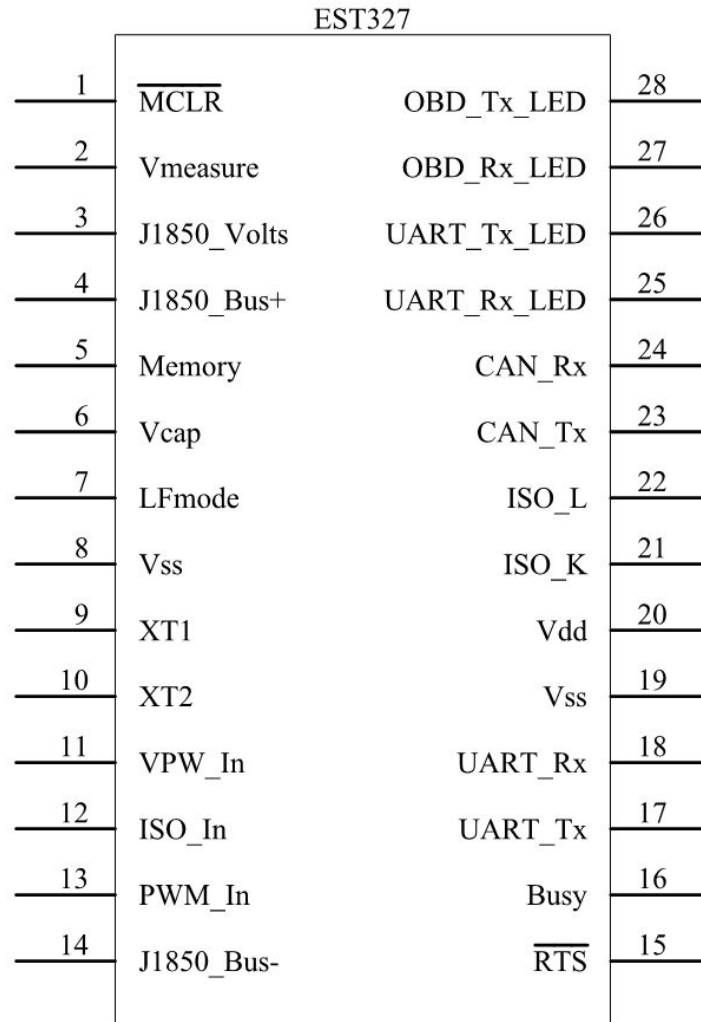- Low power CMOS design

2. Supported protocols

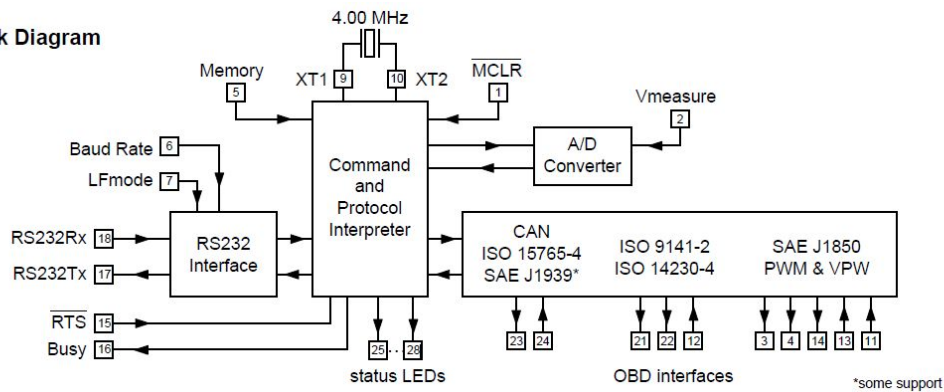| ID	Protocol Name
1	SAE J1850 PWM (41.6 Kbaud)
2	SAE J1850 VPW (10.4 Kbaud)
3	ISO 9141-2 (5 baud init, 10.4 Kbaud)
4	ISO 14230-4 KWP (5 baud init, 10.4 Kbaud)
5	ISO 14230-4 KWP (fast init, 10.4 Kbaud)
6	ISO 15765-4 CAN (11 bit ID, 500 Kbaud)
7	ISO 15765-4 CAN (29 bit ID, 500 Kbaud)
8	ISO 15765-4 CAN (11 bit ID, 250 Kbaud)
9	ISO 15765-4 CAN (29 bit ID, 250 Kbaud)
10	SAE J1939 CAN (29 bit ID, 250* Kbaud)
11	USER1 CAN (11* bit ID, 125* Kbaud)
12	USER2 CAN (11* bit ID, 50* Kbaud)

3. Pin Descriptions

EST327

1	MCLR	OBD_Tx_LED	28
2	Vmeasure	OBD_Rx_LED	27
3	J1850_Volts	UART_Tx_LED	26
4	J1850_Bus+	UART_Rx_LED	25
5	Memory	CAN_Rx	24
6	Vcap	CAN_Tx	23
7	LFmode	ISO_L	22
8	Vss	ISO_K	21
9	XT1	Vdd	20
10	XT2	Vss	19
11	VPW_In	UART_Rx	18
12	ISO_In	UART_Tx	17
13	PWM_In	Busy	16
14	J1850_Bus-	RTS	15

Block Diagram

MCLR (pin 1)

A momentary logic low applied to this input will resetthe IC. If unused, this pin should be connected to alogic high (V_DD) level.

Vmeasure (pin 2)

This analog input is used to measure a 0 to 5Vsignal that is applied to it. Care must be taken toprevent the voltage from going outside of the supplyle vels of the EST327, or damage may occur. If it isnot used, this pin should be tied to either V_DD or V_SS.

J1850 Volts (pin 3)

This output can be used to control a voltage supplyfor the J1850 Bus+ output. The pin will output a logichigh level when a nominal 8V is required (for J1850VPW), and will output a low level when 5V is needed(as for J1850 PWM applications). If this switchingcapability is not required for your application, thisoutput can be left open-circuited.

J1850 Bus+ (pin 4)

This active high output is used to drive the J1850 Bus+ Line to an active level. Note that this signal does not have to be used for the Bus- Line, since a separate J1850 Bus- drive output is provided on pin 14.

Memory (pin 5)

This input controls the default state of the memory option. If this pin is at a high level during power-up or reset,the memory function will be enabled by default. If it is at a low level,then the default will be to have it disabled.Memory can always be enabled or disabled with the AT M1 and AT M0 commands.

Vcap (pin 6)

Connect a capacitors(typically 10uF) to VSS.

LFmode (pin 7)

This input is used to select the default linefeed mode to be used after a power-up or system reset.If it is at a high level, then by default messages sent by the EST327 will be terminated with both a carriage return and a linefeed character.If it is at a low level, lines will be terminated by a carriage return only. This behaviour can always be modified by issuing an AT L1 or AT L0 command (see the section on AT Commands).

VSS (pins 8 and 19)

Circuit common must be connected to these pins.

XT1 (pin 9) and XT2 (pin 10)

A 4.000 MHz oscillator crystal is connected between these two pins. Loading capacitors as required by the crystal (typically 27pF each) will also need to be connected between each of these pins and circuit common (Vss).Note that this device has not been configured for operation with an external oscillator – it expects a crystal to be connected to these pins. Use of an external clock source is not recommended.

VPW In (pin 11)

This is the active high input for the J1850 VPW data signal. When at rest (bus recessive) this pin should be at a low logic level. This input has Schmitt trigger waveshaping, so no special amplification is required.

ISO In (pin 12)

This is the active low input for the ISO 9141 and ISO 14230 data signal. It is derived from the K Line,and should be at a high logic level when at rest (bus ecessive). No special amplification is required, as this input has Schmitt trigger waveshaping.

PWM In (pin 13)

This is the active low input for the J1850 PWM data signal. It should normally be at a high level when at rest (ie. bus recessive). This input has Schmitt trigger waveshaping, so no special amplification is required.

J1850 Bus- (pin 14)

This active high output is used to drive the J1850 Bus- Line to an active (dominant) level for J1850 PWM applications. If unused, this output can be left open-circuited.

RTS (pin 15)

This active low "Request To Send" input can be used to interrupt the OBD processing in order to send a new command. Normally high, the line is brought low for attention, and should remain so until the Busy line (pin 16) indicates that the EST327 is no longer busy. This input has Schmitt trigger waveshaping.

Busy (pin 16)

This active high output shows the current state of the EST327. If it is at a low level, the processor is ready to receive ASCII commands and characters, but if it is at a high level, commands are being processed.

RS232Tx (pin 17)

This is the RS232 data transmit output. The signal level is compatible with most interface ICs (output is normally high), and there is sufficient current drive to allow interfacing using only a PNP transistor, if desired.

RS232Rx (pin 18)

This is the RS232 receive data input. The signal level is compatible with most interface ICs (when at idle, the level is normally high), but can be used with other interfaces as well, since the input has Schmitt trigger waveshaping.

VDD (pin 20)

This pin is the positive supply pin, and should always be the most positive point in the circuit. Internal circuitry connected to this pin is used to provide power on reset of the microprocessor, so an external reset signal is not required. Refer to the Electrical Characteristics section for further information.

ISO K (pin 21) and ISO L (pin 22)

These are the active high output signals which are used to drive the ISO 9141 and ISO 14230 buses to an active (dominant) level. Many new vehicles do not require the L Line – if yours does not, you can simply leave pin 22 open-circuited.

CAN Tx (pin 23) and CAN Rx (pin 24)

These are the two CAN interface signals that must be connected to a CAN transeiver IC for proper operation. If you are connecting to an existing CAN system, the integrity of the entire system might be jeopardized if a proper interface is not used. See the Example Applications section for more information.

RS232 Rx LED (pin 25), RS232 Tx LED (pin 26),OBD Rx LED (pin 27) and OBD Tx LED (pin 28)

These four output pins are normally high, and are driven to low levels when the EST327 is transmitting or receiving data. Current capability is suitable for directly driving most LEDs through current limiting resistors, or interfacing to other logic for status reporting. If unused, these pins should be left open-circuited.

EST327

Product data sheet   **Rev.1.5 — 3 Jan 2014**   **5 of 16**

4. Electrical Characteristics

Characteristic	Min	Typical	Max	Units	Conditions
Supply voltage, Vdd	4.5	5.0	5.5	V	
Average current, Idd of normal		12		mA	EST327 device only – does not include any load currents
Average current, Idd of low power		0.15		mA	
Input logic levels of low	Vss		0.8	V	Pins 5,6,7,and 24 only
Input logic levels of high	3.0		Vdd	V	
Schmitt trigger input thresholds of rising		2.9	4.0	V	Pins 1.11.12.13.15 and 18 only
Schmitt trigger input thresholds of falling	1.0	1.5		V	
Output low voltage		0.3		V	Current(sink)=10mA
Output high voltage		4.4		V	Current(source)=10mA
A/D conversion time		9		msec	
Storage Temperature	-65		150	°C	
Ambient Temperature with Power Applied	-40		85	°C	

5. Communication standard of bluetooth

ITEM	Comment
Operating Frequency Band	2.4GHz -2.48GHz unlicensed ISM band
Bluetooth Specification	V2.1+EDR
Output Power Class	Class 2
Operating Voltage	3.3V
Host Interface	USB 1.1/2.0 or UART
Audio Interface	PCM interface
Flash Memory Size	8Mbit

6. Applications

- Mobile device integration research and development
- Diagnostic trouble code readers
- Automotive scan tools
- On-board equipment integration research and development
- Government
- Corporate fleets
- School bus safety
- Car rental
- The insurance company
- Telecom operators
- Teaching aids

7. AT COMMAND

Command	Description	Group
AL	Allow Long (>7 byte) messages	OBD
AR	Automatic Receive	OBD
AT0	Adaptive Timing Off	OBD
AT1	Adaptive Timing Auto1	OBD
AT2	Adaptive Timing Auto2	OBD
BD	perform a Buffer Dump	OBD
BI	Bypass the Initialization sequence	OBD
BRD hh	try Baud rate Divisor hh	General
BRT hh	set Baud Rate handshake Timeout	General
CAF0	CAN Automatic Formatting Off	CAN
CAF1	CAN Automatic Formatting On	CAN
CEA	turn off CAN Extended Addressing	CAN
CEA hh	use CAN Extended Address hh	CAN
CF hh hh hh hh	set the ID Filter to hhhhhhhh	CAN
CF hhh	set the ID Filter to hhh	CAN
CFC0	CAN Flow Control Off	CAN
CFC1	CAN Flow Control On	CAN
CM hh hh hh hh	set the ID Mask to hhhhhhhh	CAN
CM hhh	set the ID Mask to hhh	CAN
CP hh	set CAN Priority (only for 29 bit)	CAN
CRA	reset CAN Receive Address filters	CAN
CRA hhh	set CAN Receive Address to hhh	CAN
CRA hhhhhhhh	set CAN Receive Address to hhhhhhhh	CAN
CS	show the CAN Status	CAN
CSM0	CAN Silent Mode Off	CAN
CSM1	CAN Silent Mode On	CAN
CV dddd	Calibrate the Voltage to dd.dd volts	Volts
CV 0000	Restore CV value to factory setting	Volts
D	set all to Defaults	General
D0	display of the DLC Off	CAN
D1	display of the DLC On	CAN
DM1	(J1939) Monitor for DM1 messages	J1939
DP	Describe the current Protocol	OBD
DPN	Describe the Protocol by Number	OBD
E0	Echo Off	General
E1	Echo On	General

FC SD [1-5 bytes]	Flow Control Set Data to […]	CAN
FC SH hhh	Flow Control Set the Header to hhh	CAN
FC SM h	Flow Control Set the Mode to h	CAN
FE	Forget Events	General
FI	perform a Fast Initiation	ISO
H0	Headers Off	OBD
H1	Headers On	OBD
I	Print the ID	General
IB 10	set the ISO Baud rate to 10400	ISO
IB 48	set the ISO Baud rate to 4800	ISO
IB 96	set the ISO Baud rate to 9600	ISO
IFR H	IFR value from Header	J1850
IFR S	IFR value from Source	J1850
IFR0	IFRs Off	J1850
IFR1	IFRs Auto	J1850
IFR2	IFRs On	J1850
IGN	read the IgnMon input level	Other
IIA hh	set the ISO (slow) Init Address to hh	ISO
JE	use J1939 data format	J1939
JHF0	J1939 Header Formatting Off	J1939
JHF1	J1939 Header Formatting On	J1939
JS	use J1939 SAE data format	J1939
JTM1	set the J1939 Timer Multiplier to 1x	J1939
JTM5	set the J1939 Timer Multiplier to 5x	J1939
KW	display the Key Words	ISO
KW0	Key Word checking Off	ISO
KW1	Key Word checking On	ISO
L0	Linefeeds Off	General
L1	Linefeeds On	General
LP	go to Low Power mode	General
M0	Memory Off	General
M1	Memory On	General
MA	Monitor All	OBD
MP hhhh	(J1939) Monitor for PGN hhhh	J1939
MP hhhh n	(J1939) Monitor for PGN hhhh, get n messages	J1939
MP hhhhhh	(J1939) Monitor for PGN hhhhhh	J1939
MP hhhhhh n	(J1939) Monitor for PGN hhhhhh, get n messages	J1939
MR hh	Monitor for Receiver = hh	OBD
MT hh	Monitor for Transmitter = hh	OBD
NL	Normal Length (7 byte) messages	OBD

PB xx yy	set Protocol B options and baud rate	CAN
PC	Protocol Close	OBD
PP FF OFF	all Prog Parameters Off	PPs
PP FF ON	all Prog Parameters On	PPs
PP xx OFF	disable Prog Parameter xx	PPs
PP xx ON	enable Prog Parameter xx	PPs
PP xx SV yy	for PP xx, Set the Value to yy	PPs
PPS	print a PP Summary	PPs
R0	Responses Off	OBD
R1	Responses On	OBD
RA hh	set the Receive Address to hh	OBD
RD	Read the stored Data	General
RTR	send an RTR message	CAN
RV	Read the Voltage	Volts
S0	printing of Spaces Off	OBD
S1	printing of Spaces On	OBD
SD hh	Store Data byte hh	General
SH xx yy zz	Set Header	OBD
SH yzz	Set Header	OBD
SI	perform a Slow Initiation	ISO
SP Ah	Set Protocol to Auto, h and save it	OBD
SP h	Set Protocol to h and save it	OBD
SP 00	Set Protocol to Auto and save it	OBD
SR hh	Set the Receive address to hh	OBD
SS	set Standard Search order (J1978)	OBD
ST hh	Set Timeout to hh x 4 msec	OBD
SW hh	Set Wakeup interval to hh x 20 msec	ISO
TA hh	set Tester Address to hh	OBD
TP Ah	Try Protocol h with Auto search	OBD
TP h	Try Protocol h	OBD
V0	use of Variable DLC Off	CAN
V1	use of Variable DLC On	CAN
WM [1-6 bytes]	Set the Wakeup Message	ISO
WM xxyyzzaa	set the Wakeup Message to xxyyzzaa	ISO
WM xxyyzzaabb	set the Wakeup Message to xxyyzzaabb	ISO
WM xxyyzzaabbcc	set the Wakeup Message to xxyyzzaabbcc	ISO
WS	Warm Start	General
Z	reset all	General

8. The initialization routine

ID	TYPE	DATA	Describe
		Baud Rate: 38400	
		StopBits: 1, Parity: No, DataBits: 8	
1	S	AT Z	reset all
2	S	AT WS	warm start
3	A	EST327 v1.5	
4	S	AT E0	echo off
5	A	OK	
6	S	AT L0	linefeeds off
7	A	OK	
8	S	AT H1	heads on
9	A	OK	
10	S	AT I	version infomation
11	A	EST327 v1.5	
12	S	AT RV	read voltage
13	A	11.4V	
14	S	AT SPA6	set protocol automatic
15	A	SEARCHING	
16	S	AT DP	describe current protocol
17	A	AUTO, ISO 9141-2	
18	S	0100	obd support command
19	A	48 6B 10 41 00 FF FF DF FF E0	

9. Diagnostic Trouble Code(DTC)

a) Read DTC

Likely the most common use that the EST327 will be put to is in obtaining the current Diagnostic Trouble Codes (or DTCs). Minimally, this requires that a mode 03 request be made, but first one should determine how many trouble codes are presently stored. This is done with a mode 01 PID 01 request as follows:

>01 01

To which a typical response might be:

41 01 81 07 65 04

The 41 01 signifies a response to the request, and the next data byte (81) is the number of current trouble codes. Clearly there would not be 81 (hex) or 129 (decimal) trouble codes present if the vehicle is at all operational. In fact, this byte does double duty, with the most significant bit being used to indicate that the malfunction indicator lamp (MIL, or 'Check Engine Light') has been turned on

by one of this module's codes (if there are more than one), while the other 7 bits of this byte provide the actual number of stored trouble codes.In order to calculate the number of stored codes when the MIL is on, simply subtract 128(or 80 hex) from the number.

The above response then indicates that there is one stored code, and it was the one that set the Check Engine Lamp or MIL on. The remaining bytes in the response provide information on the types of tests supported by that particular module (see the SAE document J1979 for further information).

In this instance, there was only one line to the response, but if there were codes stored in other modules, they each could have provided a line of response. To determine which module is reporting the trouble code, one would have to turn the headers on (AT H1) and then look at the third byte of the three byte header for the address of the module that sent the information.

Having determined the number of codes stored,the next step is to request the actual trouble codes with a mode 03 request (there is no PID needed):

>03

A response to this could be:

43 01 33 00 00 00 00

The '43' in the above response simply indicates that this is a response to a mode 03 request. The other 6 bytes in the response have to be read in pairs to show the trouble codes (the above would be interpreted as 0133, 0000, and 0000). Note that the response has been padded with 00's as required by the SAE standard for this mode – the 0000's do not represent actual trouble codes.

As was the case when requesting the number of stored codes, the most significant bits of each trouble code also contain additional information. It is easiest to use the following table to interpret the extra bits in the first digit as follows:

ID	TYPE	COMMENT
0	P0	Powertrain Codes - SAE defined
1	P1	" " - manufacturer defined
2	P2	" " - SAE defined
3	P3	" " - jointly defined
4	C0	Chassis Codes - SAE defined
5	C1	" " - manufacturer defined
6	C2	" " - manufacturer defined
7	C3	" " - reserved for future
8	B0	Body Codes - SAE defined
9	B1	" " - manufacturer defined
A	B2	" " - manufacturer defined
B	B3	" " - reserved for future

C	U0	Network Codes - SAE defined
D	U1	" " - manufacturer defined
E	U2	" " - manufacturer defined
F	U3	" " - reserved for future

Taking the example trouble code (0133), the first digit (0) would then be replaced with P0, and the 0133 reported would become P0133 (which is the code for an 'oxygen sensor circuit slow response'). Note that the ISO 15765-4 (CAN) protocol is very similar, but it adds an extra data byte (in the second position), showing how many data items (DTCs) are to follow.

To provide a few further examples, if the received code was D016, you would replace the D with U1, and the resulting trouble code would be U1016. Similarly,1131 received would actually be for the code P1131.

b) Clear DTC

The EST327 is quite capable of resetting diagnostic trouble codes, as this only requires issuing a mode 04 command. The consequences should always be considered before sending it, however, as more than the MIL (or 'Check Engine Light') will be reset. In fact, issuing a mode 04 will:

- reset the number of trouble codes
- erase any diagnostic trouble codes
- erase any stored freeze frame data
- erase the DTC that initiated the freeze frame
- erase all oxygen sensor test data
- erase mode 06 and 07 information

Clearing of all of this data is not unique to the EST327 – it occurs whenever any scan tool is used to reset the codes. The biggest problem with losing this data is that your vehicle may run poorly for a short time, while it performs a recalibration.

To avoid inadvertently erasing stored information,the SAE specifies that scan tools must verify that a mode 04 is intended ("Are you sure?") before actually sending it to the vehicle, as all trouble code information is immediately lost when the mode is sent.Remember that the EST327 does not monitor the content of the messages, so it will not know to ask for confirmation of the mode request – this would have to be the duty of a software interface if one is written.

As stated, to actually erase diagnostic trouble codes, one need only issue a mode 04 command.A response of 44 from the vehicle indicates that the mode request has been carried out, the information erased, and the MIL turned off. Some vehicles may require a special condition to occur (eg. the ignition on but the engine not running) before they will respond to a mode 04 command.
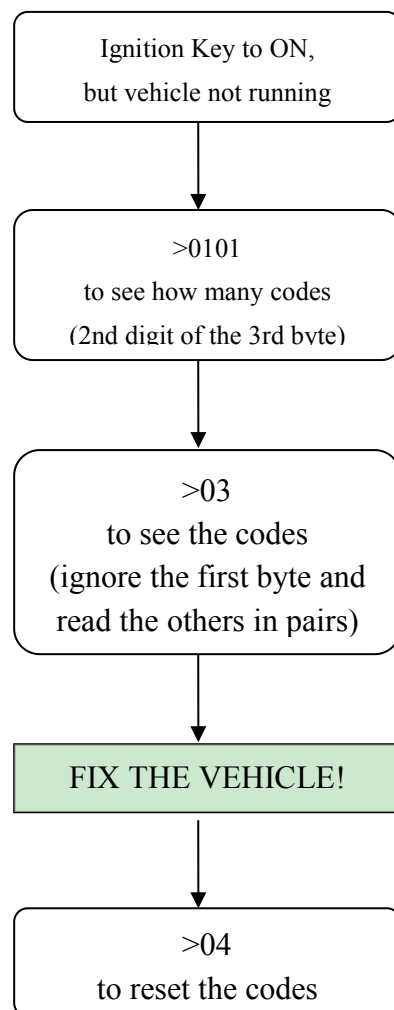
That is all there is to clearing trouble codes. Once again, do not accidentally send the 04 code!

c) Quick Guide for Reading Trouble Codes

If you do not use your EST327 for some time, this entire data sheet may seem like quite a bit to review when your 'Check Engine' light eventually comes on, and you just want to know why. We offer this section as a quick guide to the basics that you will need.

To get started, connect the EST327 circuit to your PC or PDA and communicate with it using a terminal program such as HyperTerminal, ZTerm, ptelnet, or a similar program. It should normally be set to either 9600 or 38400 baud, with 8 data bits, and no parity or handshaking.

The chart at the right provides a quick procedure on what to do next:

```
┌─────────────────────────┐
│  Ignition Key to ON,    │
│  but vehicle not running │
└─────────────────────────┘
             │
             ▼
┌─────────────────────────┐
│         >0101           │
│   to see how many codes │
│ (2nd digit of the 3rd byte) │
└─────────────────────────┘
             │
             ▼
┌─────────────────────────┐
│          >03            │
│     to see the codes    │
│ (ignore the first byte and │
│  read the others in pairs) │
└─────────────────────────┘
             │
             ▼
┌─────────────────────────┐
│     FIX THE VEHICLE!    │
└─────────────────────────┘
             │
             ▼
┌─────────────────────────┐
│          >04            │
│    to reset the codes   │
└─────────────────────────┘
```

10. Package Information

28-Lead Plastic Shrink Small Outline (SS) – 5.30 mm Body [SSOP]
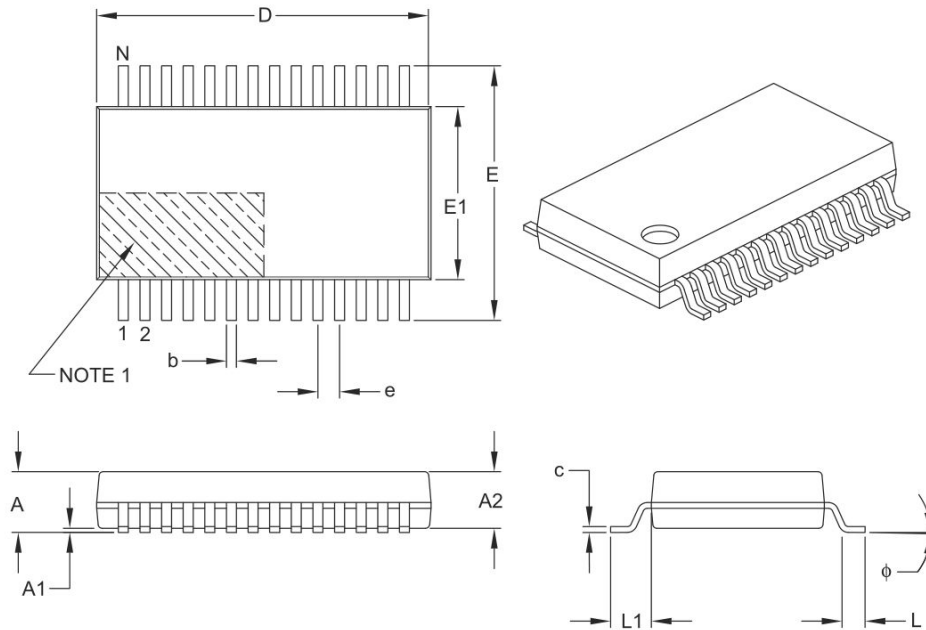
	Units		MILLIMETERS		
	Dimension Limits		MIN	NOM	MAX
Number of Pins	N			28	
Pitch	e			0.65 BSC	
Overall Height	A		–	–	2.00
Molded Package Thickness	A2		1.65	1.75	1.85
Standoff	A1		0.05	–	–
Overall Width	E		7.40	7.80	8.20
Molded Package Width	E1		5.00	5.30	5.60
Overall Length	D		9.90	10.20	10.50
Foot Length	L		0.55	0.75	0.95
Footprint	L1			1.25 REF	
Lead Thickness	c		0.09	–	0.25
Foot Angle	φ		0°	4°	8°
Lead Width	b		0.22	–	0.38

28-Lead Plastic Shrink Small Outline (SS) - 5.30 mm Body [SSOP]

RECOMMENDED LAND PATTERN
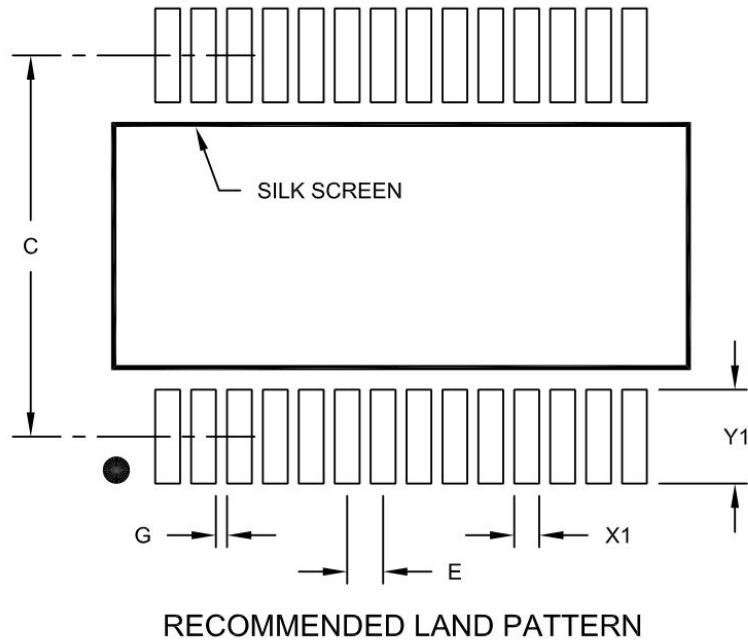
		Units	MILLIMETERS		
	Dimension Limits		MIN	NOM	MAX
Contact Pitch		E	0.65 BSC		
Contact Pad Spacing		C		7.20	
Contact Pad Width (X28)		X1			0.45
Contact Pad Length (X28)		Y1			1.75
Distance Between Pads		G	0.20		