

## Abstract

This application note provides a methodology for loading the configuration file into an Intersil Digital-DC™ device via the SMBus for commercial device programmers capable of supporting the I<sup>2</sup>C bus protocol.

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## Configuring the Intersil Controller via the SMBus

The configuration parameters can be stored in an Intersil Digital-DC device using PMBus protocol via the SDA and SCL pins. SDA and SCL are a standard I<sup>2</sup>C interface.

TABLE 1. SMBus SIGNALS

PIN SYMBOL	I/O	DESCRIPTION
SCL	I/O	SMBus clock pin
SDA	I/O	SMBus data pin

The procedure for configuring a device is described on the following page.

Intersil provides a parser program called ZLHLD, which takes the device configuration file as an input. The output file is in ZLHLD format (Zilker Labs Hex Line Delimited). [Figure 3](#) shows an example of an output file in ZLHLD format.

The pin assignments and configuration circuits for the Intersil Digital-DC devices are shown in Appendix III. All other pins must be connected to ground through a 22kΩ resistor. For any device, wait 20ms prior to the start of device programming.

When configuring a device, all standard SMBus protocols must be followed, including clock stretching. Additionally, a 2ms delay between every SMBus transmission (between every stop and start condition) must occur. Refer to the System Management Bus (SMBus) Specification, from SBS Implementers Forum for SMBus electrical and timing requirements

### Configuring Intersil Devices

Below is a sequence of steps following from design to production:

1. A configuration file is generated by the design engineer (example - [Figure 2](#)).
2. A parser (ZLHLD Generator) supplied by Intersil will convert this configuration file into a Zilker Labs Hex Line Delimited. This parser will calculate and append a Packet Error Checking (PEC) byte for all write transactions. A checksum of the ZLHLD file is also generated in a separate file for verification by the programmer.
3. An Intersil supplied low volume programmer or an industry standard high volume memory programmer, such as from BP Microsystems, may be used for configuring the devices.
4. The programmers will do the following:
  - a. Verify the Device ID:
 

All Intersil devices have a unique identifier, which is loaded into the nonvolatile memory at final test. The device ID should always be checked prior to start of configuring by the following method:

    - i. Read DEVICE\_ID (0xE4), a 16-byte identifier. The bytes written before reading are "40E441", with a repeated start performed before byte 0x41 is issued.
    - ii. Compare the first 7 bytes of the response to the Device ID under test. These first 7 bytes should be something such as "ZL2005-", "ZL2105-", "ZL2006-", etc.

- b. Insert a 6 byte serial number into the configuration file. The placement of this command is device dependent, as shown in ["Appendix I" on page 6](#). Upon generating the serial number, calculate the PEC ([Note 1](#)) and append it after the serial number. See ["Appendix II" on page 7](#) for example code on calculating the PEC. Note that for BPMicro systems, the Zilker Labs External Serialization Program (ZL\_ESP) is used to write the serial number in ASCII at the correct locations.
- c. Load ZLHLD File ([Note 2](#)) - Example in [Figure 3 on page 5](#) via I<sup>2</sup>C Bus, using SMBus protocol.
  - i. Verification that the data was written to the device is done by checking the CML bit (Bit [1]) of the STATUS\_WORD register as well as checking the contents of STATUS\_CML register to be equal to 0x00.
    - ii. After the entire config file is loaded, read STATUS\_WORD (0x79), Bit [1].
      1. If this bit is set (1), the data transfer failed and the device needs to be rejected.
      2. If this bit is clear (0), we will do a second test to verify the data communication and flash write, as shown in Step 3.
      3. Read the STATUS\_CML (0x7E) register.
      4. If the single-byte data of STATUS\_CML does NOT equal 0x00, the data transfer failed and the device needs to be rejected
      5. If the single-byte data of STATUS\_CML equals 0x00, the data transfer has succeeded.

#### NOTES:

1. When loading the configuration file, always insert a 50ms wait prior to or after the 000440F10087 string.
2. On DDC-enabled devices such as the ZL2004, ZL2006, and ZL2106, an EVENT command is inserted at the beginning of the file to put the device into a manufacturing mode. This addition is performed automatically by the ZLHLD generator when the appropriate device is selected.

### Configuring Intersil Device Flowchart

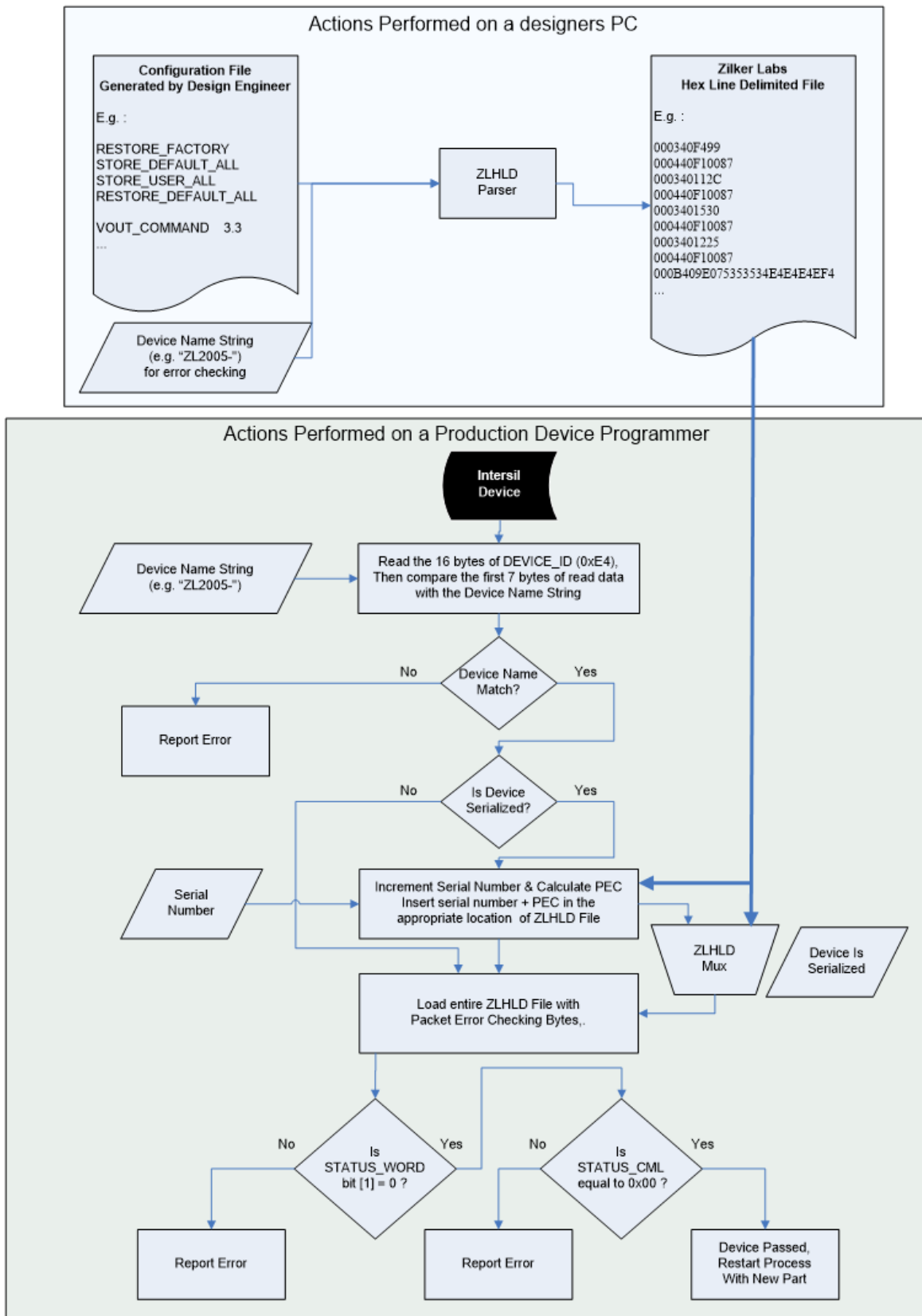


FIGURE 1. PRODUCTION PROGRAMMING FLOWCHART

## Example of ZL2005 Configuration File in Text Format

```

#-----
# Configuration file for ZL2005EV4 10A design
# The next three lines clear the Default Store & User Store
RESTORE_FACTORY
STORE_DEFAULT_ALL
STORE_USER_ALL
RESTORE_DEFAULT_ALL
MFR_SERIAL                SSSNNN
MFR_ID                    Interil
MFR_MODEL                 ZL2005EV4_Config
MFR_REVISION              Rev1.3
MFR_LOCATION              Austin_TX
VOUT_COMMAND              1.2 #V
FREQUENCY_SWITCH          600 #kHz
POWER_GOOD_DELAY          1 #ms
TON_DELAY                 15 #ms
TON_RISE                  5 #ms
TOFF_DELAY                15 #ms
TOFF_FALL                 5 #ms
SEQUENCE                  0x0000
MFR_CONFIG                0xABC1
USER_CONFIG               0x0000
PID_TAPS                  A=1993.25, B=-3688.31, C=1795.06
IOUT_OC_FAULT_LIMIT       20. #Amps
IOUT_AVG_OC_FAULT_LIMIT   15. #Amps
IOUT_UC_FAULT_LIMIT        -10. #Amps
IOUT_AVG_UC_FAULT_LIMIT   -8. #Amps
#low FET not enabled for output OV, output OV and UV count to 2
OVUV_CONFIG               0x01
IOUT_SCALE                 3.5 #mOhms
IOUT_CAL_OFFSET           0
TEMPCO_CONFIG             0xAC
NLR_CONFIG                0xA250
# Set Null PRIVATE_PASSWORD (to get correct security level even on used-but-erased part)
PRIVATE_PASSWORD          0x000000000000000000
# Set PRIVATE_PASSWORD
PRIVATE_PASSWORD          ExamplePW
#replace "ExamplePW" nine-character password
# Set UNPROTECT bits
UNPROTECT                 0xFFFFFDFFFDF7FCBFF7FFFCCFFFFFFFFFFFFFFFA1FFFFFFFFFFFF4CEE7EFEEFFF
STORE_DEFAULT_ALL
# User Store Data
# Set PRIVATE_PASSWORD, to change SECURITY_LEVEL to 3, in order to do a RESTORE_FACTORY
PRIVATE_PASSWORD          ExamplePW
RESTORE_FACTORY
# Set PUBLIC_PASSWORD
PUBLIC_PASSWORD           MyPW
#replace "MyPW" with your own four-character password
# Set PRIVATE_PASSWORD to NULL (USER_STORE Private password),
PRIVATE_PASSWORD          0x000000000000000000
# Set PRIVATE_PASSWORD
PRIVATE_PASSWORD          ExampleP2
#replace "ExampleP2" with your own nine-character password
UNPROTECT                 0xFFFFD9FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
STORE_USER_ALL
#-----

```

FIGURE 2. EXAMPLE ZL2005 CONFIGURATION TEXT FILE

---

**Example of ZL2005 Configuration File in ZLHLD (Zilker Labs Hex Line Delimited)**

```
000340F499
000440F10087
000340112C
000440F10087
0003401530
000440F10087
0003401225
000440F10087
000B409E075353534E4E4EF4
000E40990A5A696C6B65724C6162732D
0014409A105A4C323030354556345F436F6E66696729
000A409B06526576312E3325
000D409C0941757374696E5F5458B7
000540216626CA
0005403358026D
000540D400BA30
00054060C0D384
0005406180CAFB
00054064C0D32F
0005406580CA50
000540E0000055
000540D0C1AB14
000540D10000DF
000D40D50928F97B85E6FC62E07BE2
0005404680DADE
000540E7C0D399
0005404B80D562
000540E800CC6E
000440D80193
0005403880C3DA
00054039000040
000440DCAC8D
000540D750A2C9
000D40FB0900000000000000000000BB
000D40FB094578616D706C6550571A
002440FD20FFFFFFDFFF7FCBFF7FFFCCFFFFFFFFFA1FFFFFFFFF4CEE7EFEEFFF7B
000340112C
000440F10087
000D40FB094578616D706C6550571A
000340F499
000440F10087
000840FC044D79505788
000D40FB0900000000000000000000BB
000D40FB094578616D706C65503226
002440FD20FFFFFFD9FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF73
0003401530
000440F10087
```

FIGURE 3. EXAMPLE ZL2005 HEX FORMAT CONFIGURATION FILE

## Appendix I

TABLE 2. LINE LOCATIONS OF SERIAL NUMBER, BY DEVICE TYPE

PRODUCT	CONFIG FILE LINE LOCATION (Note 4)	ZLHLD FILE SERIAL DATA BYTE LOCATION (Note 3)	COMMENTS
ZL2005	5	0x31	
ZL2005-02		0x31	
ZL2005P		0x31	
ZL2105		0x31	
ZL2004		0x37	ZLHLD Byte location accounts for EVENT command insertion.
ZL2004-01		0x37	ZLHLD Byte location accounts for EVENT command insertion.
ZL2006		0x37	ZLHLD Byte location accounts for EVENT command insertion.
ZL2106		0x37	ZLHLD Byte location accounts for EVENT command insertion.

NOTES:

- The above ZLHLD serial data byte locations are calculated with the inclusion of device address, 2-byte length preamble, CRC-command delay after STORE/RESTORE commands, and PEC bytes.
- Configuration file line location does not account for the EVENT command, as it is automatically inserted by the ZLHLD Generator. Accounting for this will increase the configuration file line location by one line.

## Appendix II

```

/* PEC.c
 * Implements a CRC-8 checksum using the direct method.
 */

/* public global values */
extern unsigned char PEC_CurrentCRC; //CRC calculation of all bytes called //through CRC_Process_Byte since last call to CRC_Reset

#define CRCPoly 0x8380 //polynomial of x^8 + x^2 + x^1 + 1 in most significant 9 bits
#define CRCDone 0x0083 //CRC is done after polynomial shifts one byte

/* function prototypes */
void PEC_ProcessByte(UBYTE crclnput);
void PEC_ResetCRC(void);

unsigned char PEC_CurrentCRC;

// CRC_Process_Byte performs a direct-mode calculation of
// one byte along with a previous CRC calculation
void PEC_ProcessByte(unsigned char crclnput)
{
    unsigned short crcTemp;
    unsigned short polyTemp = CRCPoly; //polynomial shifts as opposed to CRC
    unsigned short testMask = 0x8000; //used to evaluate whether we should XOR

    //XOR previous CRC and current input for multi-byte CRC calculations
    //temporary is shifted left one byte to perform direct mode calculation
    crcTemp = ( (unsigned short)(PEC_CurrentCRC ^ crclnput) ) << 8 );

    do {
        if(crcTemp & testMask)
            crcTemp = crcTemp ^ polyTemp;

        testMask = testMask >> 1;
        polyTemp = polyTemp >> 1;
    }
    while (polyTemp != CRCDone);

    PEC_CurrentCRC = (unsigned char) crcTemp;
}

//CRC_Reset will reset PEC_CurrentCRC to 0
//this should be called before a new multi-byte calculation needs to be done
void PEC_ResetCRC(void)
{
    PEC_CurrentCRC = 0;
}

```

FIGURE 4. EXAMPLE CODE FOR CALCULATING PEC

## Appendix III. Pin Assignments and Configuration Circuits

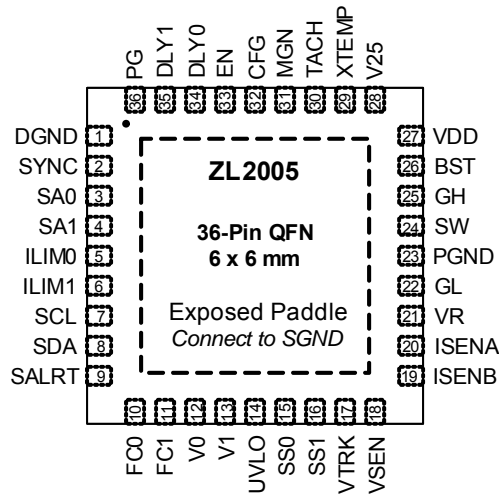


FIGURE 5. ZL2005 PIN ASSIGNMENTS (TOP VIEW)

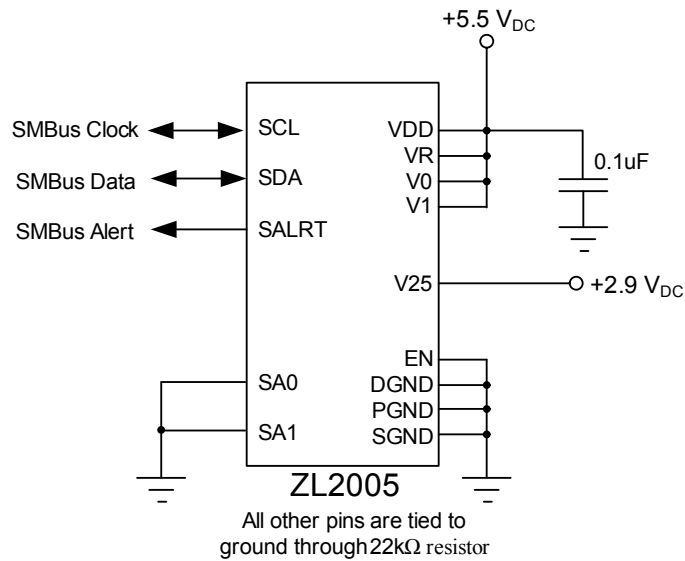


FIGURE 6. ZL2005 CONFIGURATION CIRCUIT



## Appendix III. Pin Assignments and Configuration Circuits (Continued)

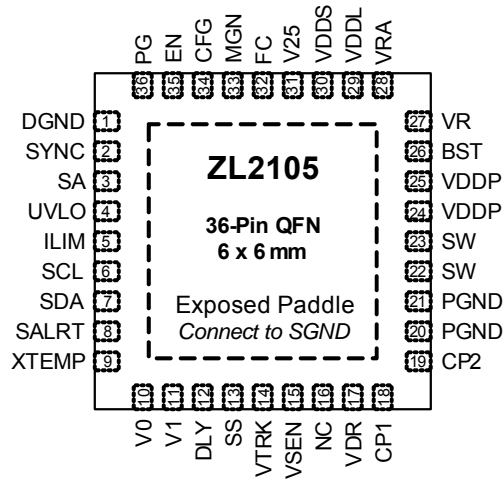


FIGURE 7. ZL2105 PIN ASSIGNMENTS (TOP VIEW)

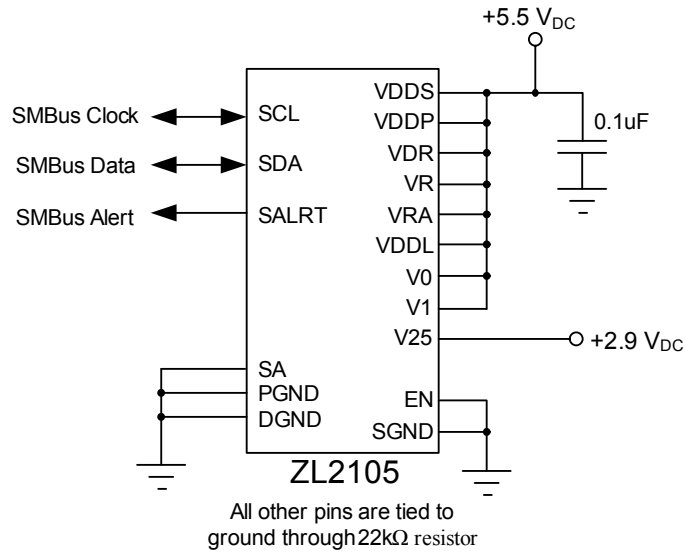


FIGURE 8. ZL2105 CONFIGURATION CIRCUIT

## Appendix III. Pin Assignments and Configuration Circuits (Continued)

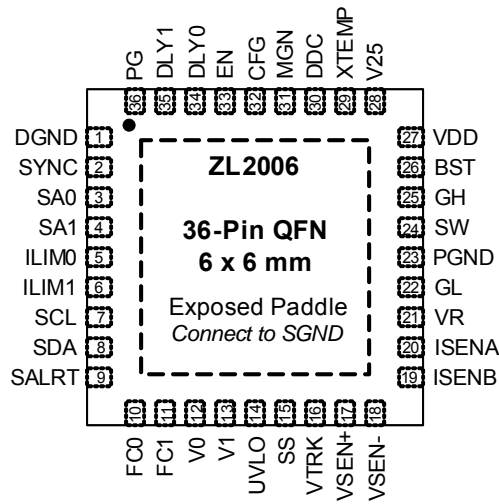


FIGURE 9. ZL2006 PIN ASSIGNMENT (TOP VIEW)

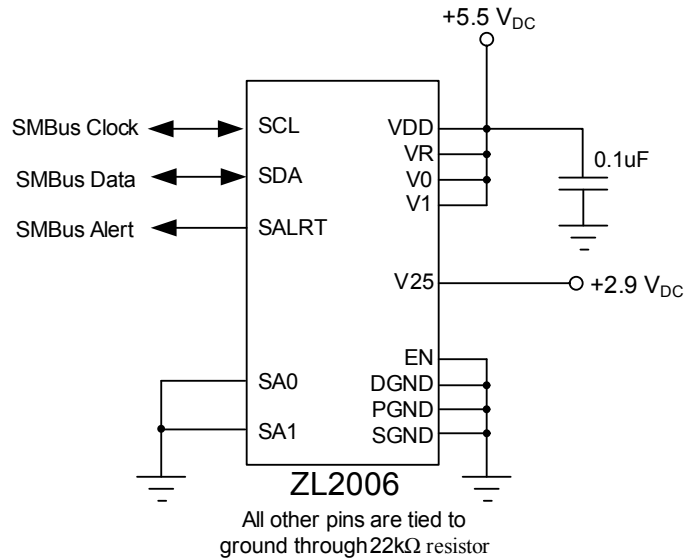


FIGURE 10. ZL2006 CONFIGURATION CIRCUIT

## Appendix III. Pin Assignments and Configuration Circuits (Continued)

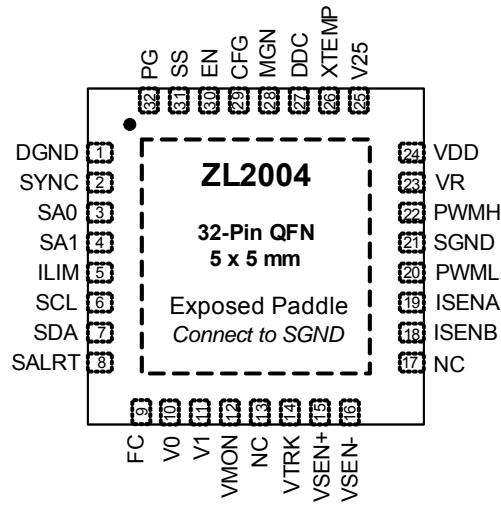


FIGURE 11. ZL2004 PIN ASSIGNMENT (TOP VIEW)

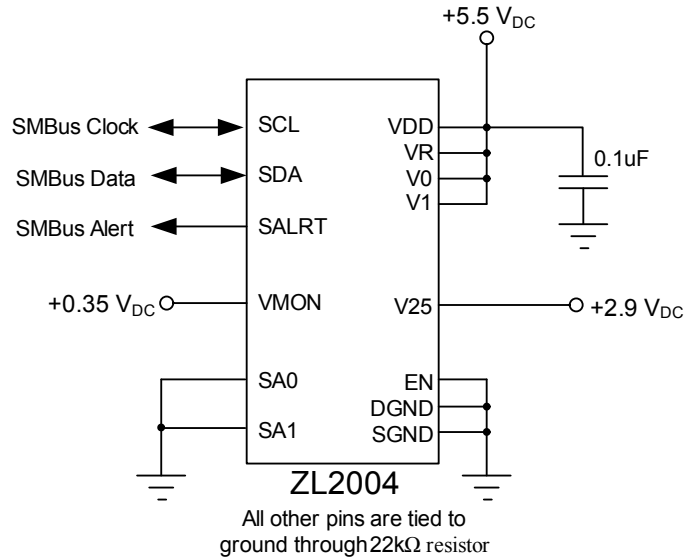


FIGURE 12. ZL2004 CONFIGURATION CIRCUIT

## Appendix III. Pin Assignments and Configuration Circuits (Continued)

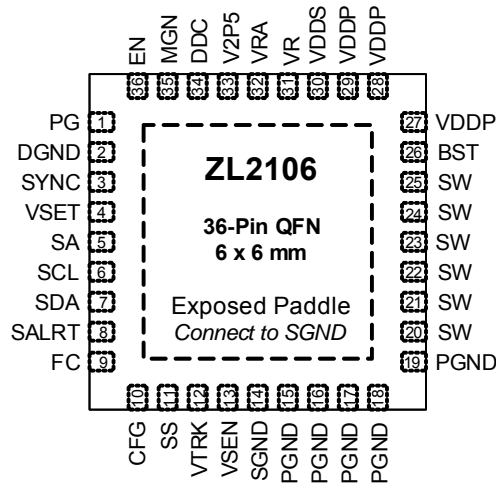
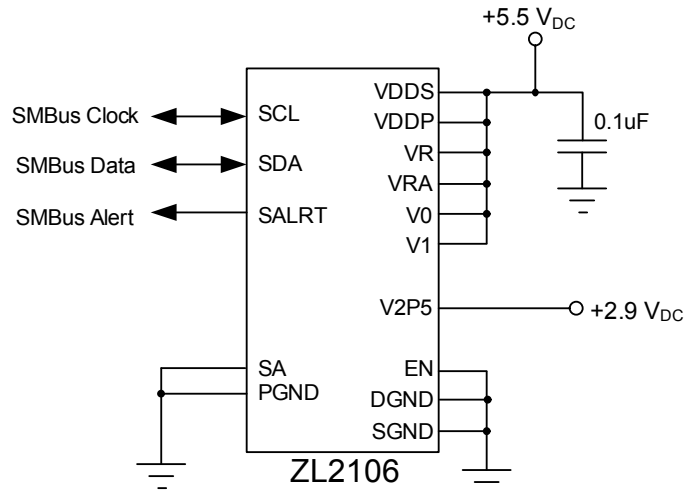


FIGURE 13. ZL2106 PIN ASSIGNMENT (TOP VIEW)



All other pins are tied to ground through 22kΩ resistor

FIGURE 14. ZL2106 CONFIGURATION CIRCUIT

## Revision History

DATE	REVISION #	DESCRIPTION
September 2007	0.5	Initial Release
October 28, 2007	0.6	Added ZL2005 and ZL2105 pin assignment diagrams Added ZL2105 configuration circuit
October 31, 2007	0.75	Added updated ZLHDC support for passwords and final Hex file format
November 27, 2007	0.8	Updated Figure 2 and Figure 4 pin configuration Added PEC to description on Page 3
December 6, 2007	0.85	Added configuration flowchart Added example code for calculating PEC
March 6, 2008	0.95	Modified Configuration Example Circuits to avoid factory VIN fault limits from causing SALRT to prematurely drop
April 1, 2008	0.96	Added ZL2006, ZL2004 schematics
April 30, 2008	0.97	Changed verification from SALRT to READ STATUS WORD
May 30, 2008	0.98	Updated to include additional STATUS_CML read, change to serial data byte locations
June 16, 2008	1.0	Added ZL2106 device
May 1, 2009	AN2030.0	Assigned file number AN2030 to app note as this will be the first release with an Intersil file number. Replaced header and footer with Intersil header and footer. Updated disclaimer information to read "Intersil and it's subsidiaries including Zilker Labs, Inc." No changes to application content.
April 1, 2016	AN2030.1	Applied Intersil's current standards throughout the document. On page 2, updated 750 $\mu$ s delay to 2ms delay in fifth paragraph.

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