

# LifeScan 9-Pin Cable

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## 1 Product Overview

The function of the LFS 9-Pin cable is to connect LifeScan BGM Meters with a 3 pin data port to an IBM PC compatible computer running IN TOUCH software (through the RS232F serial port) to permit electronic transport of data between the two.

The LFS 9-Pin cable is composed of a DB9S connector, with embedded electronics built into the DB9S connector housing, flexible shielded 3-wire cable (with separate Transmit, Receive and Ground lines), and a 3.5mm miniature stereo phone plug connector.

The embedded electronics in the 9-Pin Interface Cable provides RS232F to TTL/CMOS logic level translation.

Power for the embedded electronics is derived from the host IBM PC's RS232F port.

## 2 Specifications

### 2.1 Functional

The LFS 9-pin cable is a RS232 Serial Interface cable that allows communication between a LFS BGM and an IBM compatible PC through RS232 serial (COM) port.

The maximum baud rate of LFS 9-pin cable is 57.6K and shall operate in full duplex mode.

### 2.2 Electro-mechanical

The LFS 9-pin cable is a 48" long (including connectors), 3 core, 26 AWG, UL approved shielded cable terminated at one end with DB9S female connector with thumbscrews that will fit into a standard 9-Pin male RS232 Serial Port on any IBM Compatible PC. The other end of the cable is terminated with a 3.5mm stereo phone plug connector that will fit into a 3-pin data port of any of the LFS BGMs.

## 3 Architecture

The LFS 9-pin cable has RS232 transceiver logic near the DB9S end, which is accommodated inside the plastic hood of DB9S connector. The selection of components for the transceiver logic was accomplished after a detailed survey of the existing technology and analysis of

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the hardware requirement of LFS. In the process, the following components were selected for the design. The most critical component in the design is the RS232 transceiver IC

- **RS232 Transceiver:** IC **MAX3381E** (U2) has been selected for this purpose. The MAX3381E is a transceiver, which fully meets the EIA-232 serial communication standard while operating with a single +2.35V to +5.5V power supply. The device features an on-board charge-pump and DC-to-DC converter, eliminating the need for dual power supplies.

The MAX3381E is suitable for operation in harsh electrical environments and contains ESD protection up to  $\pm 15\text{KV}$  on all I/O lines (all TTL/CMOS and RS232 Inputs and Outputs, except INVALID pin). This invalid pin is left unused and does not require any protection from ESD.

The MAX3381E has two receivers and two transmitters. The proprietary low-dropout transmitter output stage enables true RS-232 performance from a +3.1V to +5.5V supply with a dual charge pump. The Max3381E is capable of transmitting data at rates of 250kbps and it offers a slower slew rate for applications where noise and EMI are issues.

- **Linear Regulator:** IC **LP2985-3.8** (U1) has been selected for this purpose. The LP2985-3.8 is a low power 150mA low dropout linear regulator, which along with a series diode is used to feed +3.6V to +3.65V to the above said RS232 transceiver (IC MAX3381E). This regulator operates over a junction temperature of  $-40$  degree C to  $+125$  deg. C and has over temperature / over current protection. The output voltage accuracy is 1%.
- **Input Capacitors:** The 1uF tantalum capacitor (C3), 0.1uF ceramic capacitor (C4) are placed on the Vin line and 0.01uF NPO capacitor (C11) on the Bypass line of LDO regulator. This is done as per the recommendations of LDO regulator data sheets. The Bypass capacitor reduces the noise at the regulator output and the other two capacitors provide a stable input to the regulator.
- **Output Capacitors:** A 10uF low ESR tantalum capacitor (C1) is required for the smooth functioning of LDO regulator particularly at high current situations and a 0.1uF ceramic capacitor (C2) is used for the decoupling purpose. These capacitors are used as per the recommendation of National Semiconductors datasheets. Another 0.1uF ceramic capacitor (C9) is used as decap for Maxim IC.
- **Charge Pump Capacitors:** The 0.1uF ceramic capacitors (C5, C6, C7 & C10) are required for the voltage doublers section of the MAX3381E as per Maxim IC recommendation datasheets.

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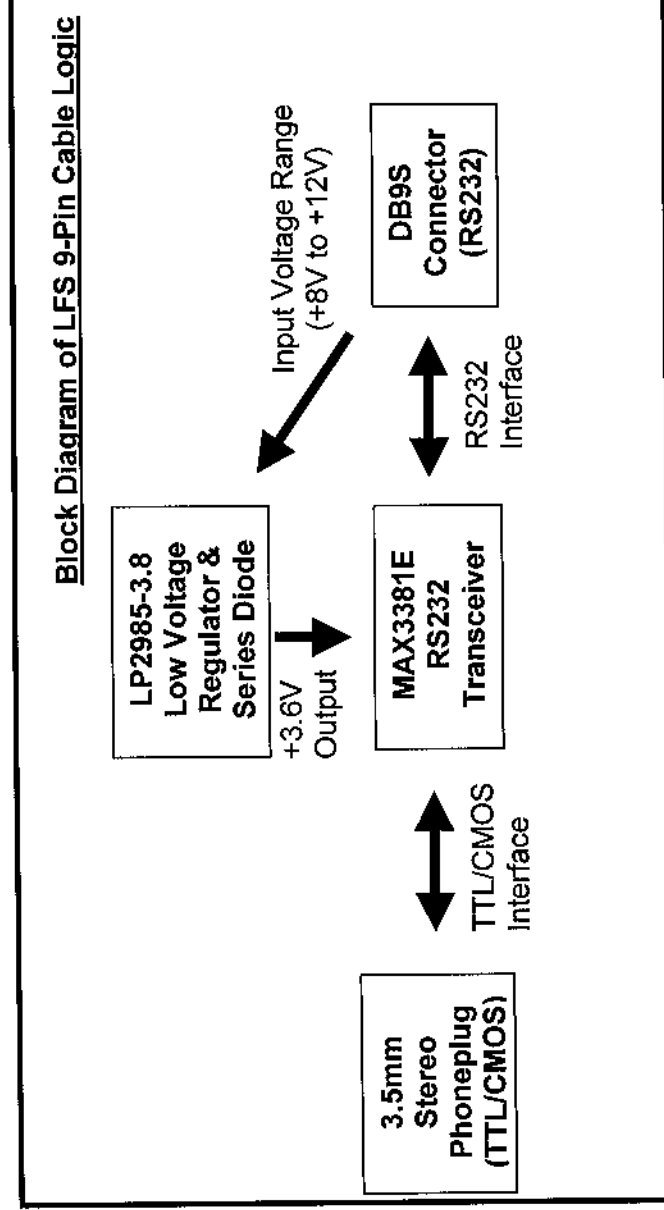
- **Resistors:** Two 3.9K resistors (R1 & R2) are used as per the specification in HWRD-021 for complimentary signal handshaking purpose.
- **Input Diodes:** Two schottky diodes (D1 & D2) are placed in series with the RTS and DTR lines of the DB9 connector respectively to prevent negative voltage appearing at the input of the regulator as the RTS and DTR lines will always carry negative voltage in the range -8V to -12V whenever the COM port is inactive.
- **Output Diode:** A low voltage drop schottky diode (D3) with Forward voltage drop ( $V_f$ ) of 0.15V to 0.2V is placed in series with the output of the regulator to suppress the reverse voltage injected by some models of BGM (viz., INDuo & OT Ultra). Thus due to the low voltage drop by the series diode, ~3.6V is fed to the above said RS232 transceiver (IC MAX3381E).

## 4 Design Implementation

### 4.1 Design description

A brief description of design is being given underneath.

**LFS-9pinCable – Sch-MAX.PDF:** This schematic sheet provides the detailed logic of the LFS 9-Pin Cable. The major functional blocks are the DB9S connector that provides RS232 interface with IBM compatible PC, a RS232 transceiver, Low drop out regulator and a 3.5mm stereo phone plug that provide TTL/CMOS interface with LFS BGM.



The detail function of each block is as follows:

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**DB9S Connector:** This connector is an Industry standard 9 pin female D-Sub connector used for serial (RS232) communication. The pin details of DB9S connector are as follows:

| Pin number    | Pin Description                                    |
|---------------|----------------------------------------------------|
| 1             | Data Carrier Detect (DCD) - Not used in our design |
| 2             | Receive Data (RXD) - input to PC                   |
| 3             | Transmit Data (TXD) - output from PC               |
| 4             | Data Terminal Ready (DTR) - output from PC         |
| 5             | Ground (GND) -Common Ground                        |
| 6             | Data Set Ready (DSR) - input to PC                 |
| 7             | Request to Send (RTS) - output from PC             |
| 8             | Clear to Send (CTS) - input to PC                  |
| 9             | Not Applicable                                     |
| Connector Tab | Chassis ground                                     |

The function of this 9-Pin connector is to provide RS232 interface between PC and RS232 transceiver IC inside the Lifescan cable.

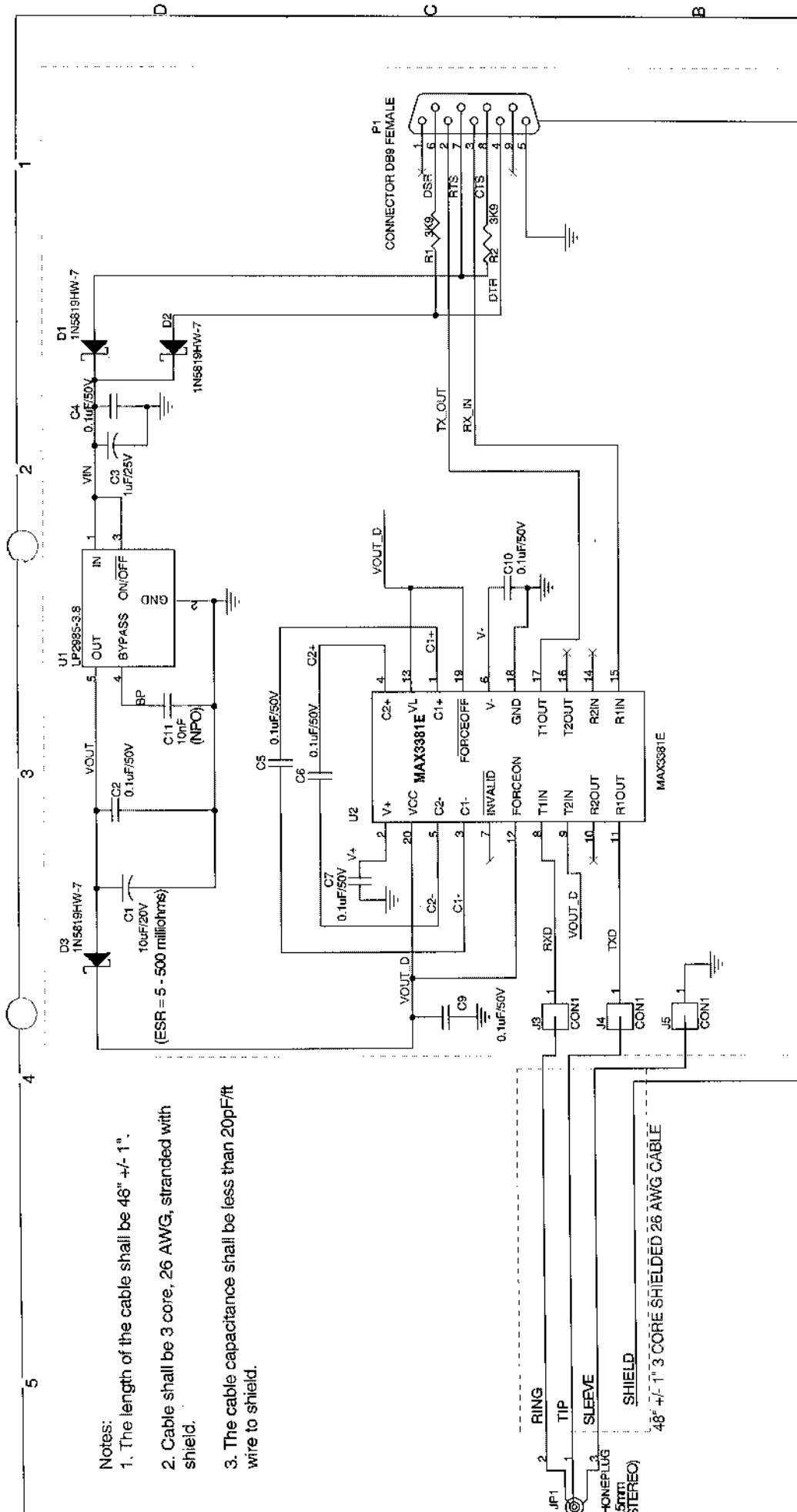
**RS232 Transceiver:** IC MAX3381E is used for this purpose. The RS232 transceiver, which is also known as the Level Translator is used to translate the data from RS232 level to TTL/CMOS level and vice versa through its RX and TX pins.

**Low Drop Voltage Regulator:** The function of the low drop voltage regulator (IC LP2985-3.8) is to step down the input voltage (ranging between +8V to +12V) from PC to +3.8V. The regulator can operate in a voltage range of +2.5V to +16V. The regulator along with a series diode (D3) is used to feed +3.6V to +3.65V to the above said RS232 transceiver (IC MAX3381E) which can operate with the input voltage range +2.35V to +5.5V. The input voltage to the regulator is fed through Pin 4 (DTR) and Pin 7 (RTS) of DB9S connector.

**3.5mm Phone plug:** This is a Industry standard 3.5mm diameter 3-pin plug used to connect 3-pin data port of LFS BGM meters. The tip of the plug transmits the data and the ring of the plug receives the data from LFS BGM. The sleeve of the phone plug is connected to the logic ground of the BGM. The shield of the cable floats at the meter-end and is connected to the shell of the DB9S connector at the PC-end.

| Pin Name | Pin Description                      |
|----------|--------------------------------------|
| Tip      | Transmit Data (TXD) - output from PC |
| Ring     | Receive Data (RXD) - input to PC     |
| Sleeve   | Ground (GND) -Common Ground          |

- Notes:
1. The length of the cable shall be 48" +/- 1".
  2. Cable shall be 3 core, 26 AWG, stranded with shield.
  3. The cable capacitance shall be less than 20pF/ft wire to shield.



# PCB LOGIC

Doc ID: HCLPLFS001 SCH 002

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Designed by:  
**HCL**  
 CAD SOFTWARE:  
 OrCAD V9.2

EXTERNAL REVIEWER (Client)  
 Pinaki Ray  
 Curt Eyster  
 Hamid Nabizadeh

| EXTERNAL REVIEWER | DEPT. | APPROVAL | DATE | INTERNAL REVIEWER | SIGN | DATE |
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Title:  
 Lifescan 9-Pin Cable

Doc Name:  
 Serial Communication Interface

Size: B SHEET 2 OF 2

# LifeScan 9-Pin Cable

Bill of Materials HCL

HCL Peripherals (A Unit of HCL Infosystems Ltd.)

| Item         | SS No. | Description                                                                                                                     | Quantity | Reference                   | Package            | Vendor/s                              | Part Number/s    |
|--------------|--------|---------------------------------------------------------------------------------------------------------------------------------|----------|-----------------------------|--------------------|---------------------------------------|------------------|
| 1            | 10001  | IC MAX3381E, RS-232 Transceiver, ESD protected, 20 pin TSSOP, Tape & Reel pkg.                                                  | 1        | U2                          | 20 pin TSSOP       | Maxim                                 | MAX3381ECUP-T    |
| 2            | 10002  | IC LP2985-3.8, Low Dropout Linear Regulator, 5 pin SOT-23, Tape & Reel pkg.                                                     | 1        | U1                          | 5 pin SOT-23       | National Semiconductor                | LP2985AIM5-3.8   |
|              |        |                                                                                                                                 |          |                             |                    | Kemet                                 | T494C106M020AS   |
|              |        |                                                                                                                                 |          |                             |                    | AVX                                   | TPSC106M025R0500 |
|              |        |                                                                                                                                 |          |                             |                    | Vishay Sprague                        | 593D106X0020C2T  |
| 3            | 10003  | Capacitor Tantalum 10uF, +/-20%, 20V or 25V, Low ESR(<= 500 milliohms), Case C, Tape & Reel pkg.                                | 1        | C1                          | Case C             | Panasonic-ECG                         | EEJL1DC106R      |
|              |        |                                                                                                                                 |          |                             |                    | Kemet                                 | T491B105M035AS   |
|              |        |                                                                                                                                 |          |                             |                    | AVX                                   | TAJB105K035RNJ   |
|              |        |                                                                                                                                 |          |                             |                    | Vishay Sprague                        | 293D105X0035B2T  |
| 4            | 10004  | Capacitor Tantalum 1uF, +/-10/ 20%, 35V, Case B, Tape & Reel pkg.                                                               | 1        | C3                          | Case B             | Panasonic-ECG                         | ECSH1VX105R      |
|              |        |                                                                                                                                 |          |                             |                    | Kemet                                 | C0805C104Z5RAC   |
|              |        |                                                                                                                                 |          |                             |                    | AVX                                   | 08055C104KAT2A   |
|              |        |                                                                                                                                 |          |                             |                    | Vishay Sprague                        | VJ0805Y104KXAAAT |
|              |        |                                                                                                                                 |          | C2, C4, C5, C6, C7, C9, C10 |                    | BC Components                         | 225211341104     |
| 5            | 10005  | Capacitor Ceramic 0.1uF/50V, +/-80% - 20%, 0805, Tape & Reel pkg.                                                               | 7        |                             | 0805               | TDK                                   | C2012X7R1H104KT  |
|              |        |                                                                                                                                 |          |                             |                    | Kemet                                 | C1206C103M4GAC   |
|              |        |                                                                                                                                 |          |                             |                    | AVX                                   | 12063A103KAT2A   |
|              |        |                                                                                                                                 |          |                             |                    | Vishay Sprague                        | VJ1206A103KXAAAT |
|              |        |                                                                                                                                 |          |                             |                    | BC Components                         | 225205441103     |
| 6            | 10006  | Capacitor Ceramic 0.01uF/16V or 25V, +/-20%, NPO, 1206, Tape & Reel pkg.                                                        | 1        | C11                         | 1206               | TDK                                   | C3216C0G1H103JT  |
|              |        |                                                                                                                                 |          |                             |                    | ROHM                                  | MCR10EZJH392     |
|              |        |                                                                                                                                 |          |                             |                    | EUROHM/Anglia                         | RK392            |
|              |        |                                                                                                                                 |          |                             |                    | AVX                                   | CR21392FT        |
|              |        |                                                                                                                                 |          |                             |                    | PhyComp                               | 232273463902     |
|              |        |                                                                                                                                 |          |                             |                    |                                       | 231232473902 or  |
| 7            | 10007  | Resistor MFR 3K9, 1/8W, 0805, +/-1%, T                                                                                          | 2        | R1, R2                      | 0805               | BC Components                         | DCU08051%PA3900  |
| 8            | 10008  | Diode Schottky, 1A, Tape & Reel pkg.                                                                                            | 3        | D1, D2, D3                  | SOD-123            | Diodes Inc.                           | 1N5819HW-7       |
| 9            | 10009  | Connector 9 Pin D-Sub Female Straight, I                                                                                        | 1        | P1                          | Panel Mount        | Acon                                  | DBW20-09K1300    |
|              |        |                                                                                                                                 |          |                             |                    | Shogyo Connectors                     | MP-0191C         |
| 10           | 10010  | Phoneplug 3.5mm (STEREO) - 3 Pin with                                                                                           | 1        | JP1                         | Straight Plug type | Win Connectors                        | BDC-0210         |
|              |        |                                                                                                                                 |          |                             |                    | Excel Circuits, India                 |                  |
|              |        |                                                                                                                                 |          |                             |                    | III-Q Electronics, India              |                  |
| 11           | 10011  | PCB "LF5MX-A", Area:24mm x 16mm, +/-0.05, 2 Layer, 1.6mm Thickness, UL mark                                                     | 1        |                             |                    |                                       |                  |
|              |        |                                                                                                                                 |          |                             |                    | Evernew Wire & Cable Co. Ltd, Taiwan  |                  |
| 12           | 10012  | Cable wire 3 core, 26AWG stranded with shield (Cable capacitance less than 20pF/ft. wire to shield), UL444, PMS430C - 48 inches | 1        |                             |                    | Chia Shin Enterprises Co.Ltd., Taiwan | PVC91155         |
| 13           | -      | PVC granules for outer mold, UL Grade, 75 deg. C, Colour: PMS430C                                                               | 30 g     |                             |                    |                                       |                  |
| Project Name |        | Document Name                                                                                                                   |          | Project Code                |                    | Revision ID & Rev.No.                 |                  |
| Lifescan 9-  |        | Bill of Materials                                                                                                               |          | HCLP-LFS-001                |                    | HCLPLFS001_BOM_002 Rev.A              |                  |
|              |        |                                                                                                                                 |          |                             |                    | G.Bala Krishnan                       |                  |