



Infusion System Service Manual



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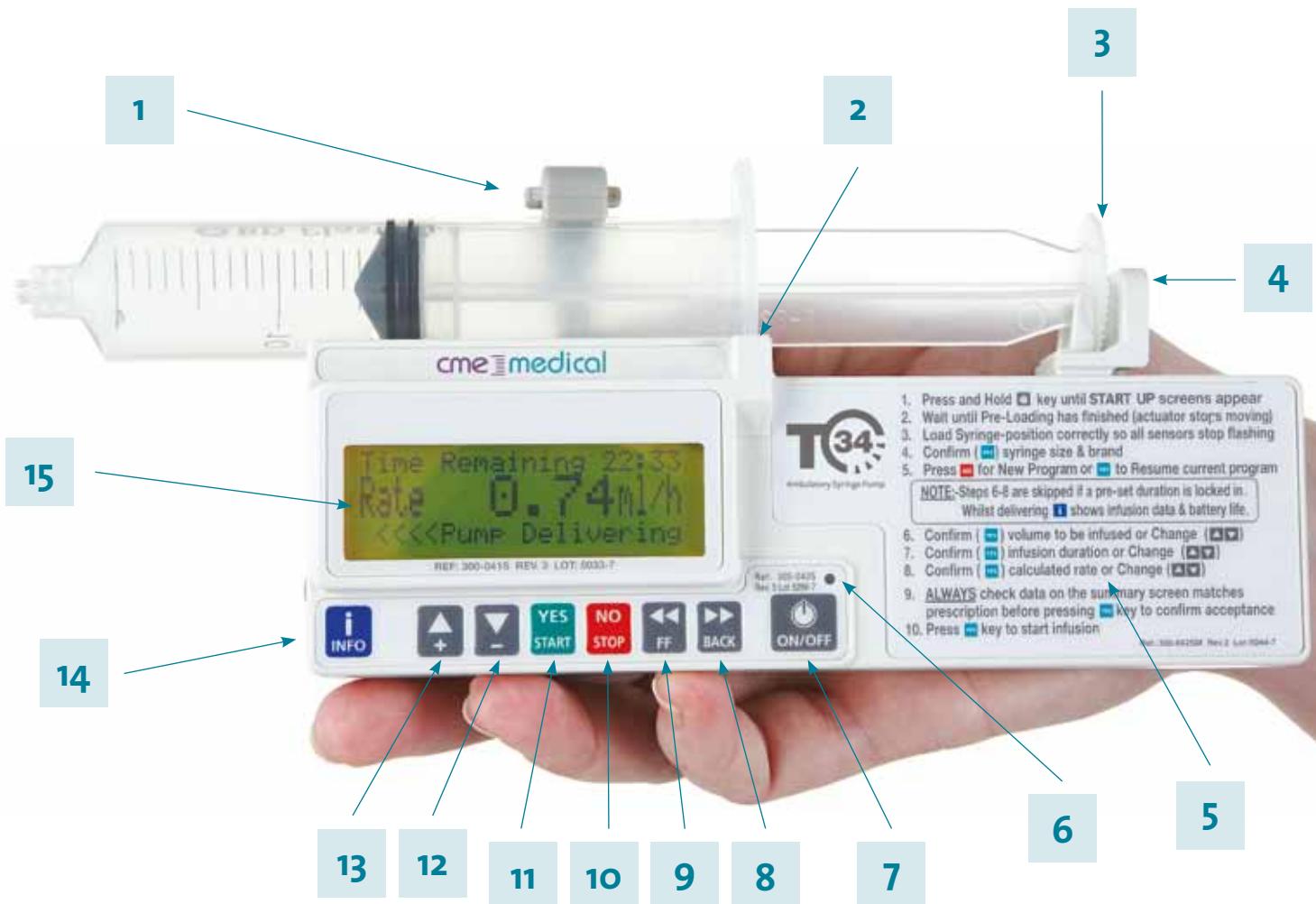


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Introduction



Introduction to the T34



- 1 Syringe holder arm (detects syringe size based on barrel diameter)
- 2 Syringe ear/collar sensor (detects correct loading of syringe collar)
- 3 Plunger sensor (detects correct loading of syringe plunger)
- 4 Actuator (drives the syringe plunger to deliver syringe contents)
- 5 Instructions for infusion set up
- 6 Operation LED (green when infusing, red when stop or alarm. Can be disabled)
- 7 On/Off key (turns the pump on and enables the user to turn it off from stop)
- 8 Back (reverse) key (moves actuator backward when no syringe present)
- 9 FF (forward) key (moves actuator forward when no syringe loaded)
- 10 No/Stop key (takes user back a step during programming; stops pump)
- 11 Yes/Start key (confirms choices during programming)
- 12 Down arrow key (decreases infusion parameters; scrolls between options)
- 13 Up arrow key (increases infusion parameters during programming and use; scrolls between options)
- 14 Info key (shows event log, volume infused, volume to be infused and battery status; long press will lock/unlock keypad)
- 15 Graphic LCD (128 pixels x 32 pixels with programmable backlight duration; when any key is pressed the backlight turns on)

Overview

The T34 is a lightweight, battery-powered infusion pump, designed for ambulatory use in a hospital or homecare setting. It can deliver indicated medications via any common infusion route, including intravenous and subcutaneous. It is suitable for adult or paediatric use.

The T34 has a three-point syringe detection, by which it can identify all commonly used syringe brands. It may also be programmed to detect other syringes. This feature enables the pump to calculate the syringe volume and, depending on the mode of operation, to deliver the contents over a specified duration or at a specified rate, in millilitres per hour, therefore minimizing the risk of programming errors. Sensors activate an alarm if the syringe is removed or displaced during infusion.

Other safety features include access-code protection, keypad lock and event log.

MODES OF OPERATION

The pump can be configured and locked to one of three modes of operation (the default mode of operation is Lock On). The mode-of-operation options are:

Lock On: Delivers the contents of the syringe over a fixed, pre-programmed duration (the pump default is 24 hours). The pump automatically calculates the ml/h infusion rate for the confirmed deliverable volume.

Lock Off: This mode permits the user to set a custom duration for delivery of the infusion. The pump automatically calculates the ml/h infusion rate based on the selected duration of delivery and the confirmed deliverable volume.

Rate mode: Permits the user to set the required flow rate, in ml/h. The pump detects the volume of the syringe and calculates the duration of the infusion accordingly.

INTENDED USE

The T34 syringe pump is designed for the infusion of medications or fluids that require continuous or intermittent delivery at precisely controlled infusion rates. It can deliver these medications through all clinically acceptable routes of administration, including intravenous; subcutaneous; percutaneous; epidural, in close proximity to nerves; and directly into an intra-operative site (soft tissue/body cavity/surgical wound site).

The system is intended for patients who require maintenance medications, analgesics, chemotherapeutic agents, or general fluids therapy. It is suitable for use in both the hospital and homecare environment.



Technical overview

Syringe pumps are ideal for low-volume applications where accuracy is important.

A syringe pump is often called a piston pump, as the fluid is moved by the syringe piston. The accuracy of the pump is determined mainly by the syringe used, and to a much lesser extent is determined also by the accuracy of the pump itself.

The driving mechanism is always a lead screw, rotated either by a stepper motor or by a permanent-magnet motor with a gearbox. The T34 uses a permanent-magnet motor, which can deliver the same torque as a stepper motor but from a much smaller unit, and because it draws much less current than a stepper motor of comparable rating. Both of these factors are significant in a pump for which size and battery life are important.

When testing a syringe pump at low rates it is important to let the unit run long enough to take up the system backlash before attempting to measure volumetric accuracy. The T34 includes a Technician menu which speeds up this process: as the displacement rate is determined by the lead screw pitch and the rate of the optical shaft encoder pulses, the need to adjust the device is eliminated.

OCCLUSION DETECTION IN THE T34

To keep battery size down the T34 does not use a strain gauge to measure occlusion force; instead, the motor current is monitored by a linear amplifier. The resulting voltage is roughly proportional to force.

While this system is not as accurate as a strain gauge in a bridge configuration, it is adequate for the intended application of the pump.

The system specification for a nominal occlusion alarm of 540mmHg is 380mmHg - 700mmHg. Variations in friction of the syringe will affect the occlusion pressure, so it is important to use a new syringe when verifying performance. A syringe friction rapidly increases after only a few occlusion measurements.

MOTOR CONTROL IN THE T34

Motor rotation is monitored by an optical shaft encoder and a rotating magnet. The microprocessor uses data from both to confirm the motor speed.

The rotating magnet on the motor shaft operates a reed switch positioned just below the shaft end of the motor. A slotted disc on the end of the lead screw, together with an IR LED and photodiode, form a shaft encoder to monitor lead screw position.

Two more reed switches, one at each end of the lead screw, slow the motor as the actuator approaches the end stop.

The motor can be stopped, started or reversed by means of an H Bridge driving circuit.* With a large syringe size and a high occlusion setting the motor current can easily exceed 100mA, so it is important that an alkaline battery is used. The zinc carbon type cannot provide the high current required as occlusion occurs.

* An H-bridge is an electronic circuit that enables a voltage to be applied across a load in either direction, to allow a DC motor to run forward and backward. H-bridges are available as integrated circuits, or they can be built from discrete components.

As with most modern products, all functions are controlled by a microprocessor. The main crystal clock for the processor is checked against the RTC clock source to ensure correct timing; a watchdog timer is also employed to shut down the motor and keypad in the event that the micro program stops executing.

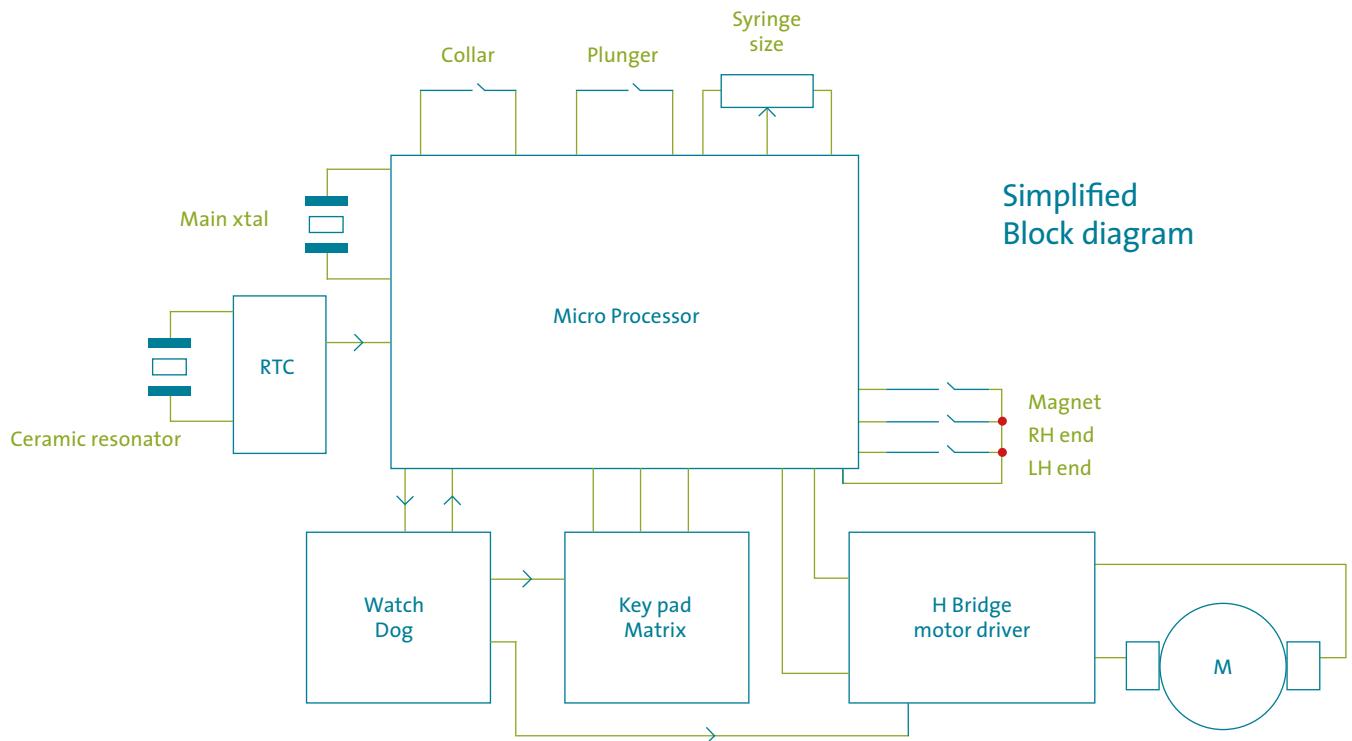
The motor speed is locked via the encoder to the checked crystal source and confirmed by the motor reed switch pulses. There is no provision for speed adjustment as there is no need for it.

On power up the microprocessor carries out a self test on most subsystems, including the motor and encoders.

PERFORMANCE VERIFICATION

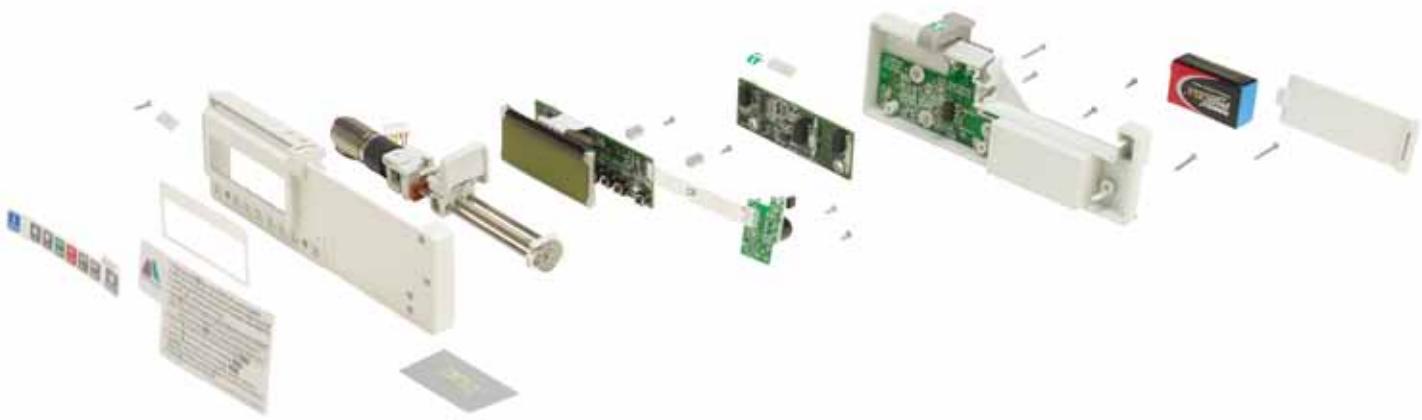
There are a number of items that the microprocessor cannot test without human intervention. These are the display and LEDs, acoustic alarm, keypad matrix, syringe size potentiometer, collar micro switch, plunger micro switch and accuracy of occlusion detection.

These items need to be manually tested, by entering Technician Mode and scrolling to the Main Self-Test Menu, where several automated test routines allow rapid confirmation of all system alarms and functions.



Service overview

This manual provides instructions for the service of the T34 syringe pump and its software. It is intended to support CME Medical-authorised service technicians.



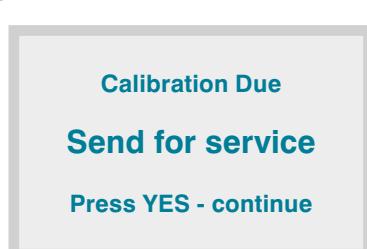
The following requirements and conditions apply when performing service on CME Medical products. Failure to follow these instructions will invalidate the warranty and may also create unacceptable risk:

- Service of T34 syringe pumps and accessories may only be performed by CME Medical authorised service personnel. Service may only be performed with the recommended equipment and CME Medical approved parts.
- Clinical personnel, patients, and other users are advised to return syringe pumps to an authorised service centre for service.
- Refer to the operation manual for pump operation instructions, cautions and warnings.
- Refer to the Bodycomm operations manual for Bodycomm operation instructions.
- Document the service performed in accordance with the service provider's maintenance test procedures.

CME Medical recommends that the T34 is serviced every 12 months. The unit can be programmed via the pump or the Bodycomm software to alert the user when it is due for service or calibration. When the programmed time is reached the message below will be displayed each time the device is powered up (the T34 is not disabled but can continue to be used after the alert has been triggered).

The unit can only be reset after it has been fully serviced. Please refer to the procedure after User Mode Functional Testing (Normal Operation Mode) in this service manual.

Message displayed:



T34 technical specifications

Device type	Syringe pump with motor-driven linear actuator, pulsed motion (540 pulses per mm)		
Flow rate	0.05–10ml/h in 0.01ml increments, 10–650ml/h in 1ml increments		
Actuator stroke	67mm available		
Syringe sizes	2–50ml (most commonly used)		
System accuracy	±5%		
Occlusion pressure	Configurable to 150–1500mmHg (10mmHg increments). Maximum actuator force 50N (5kgf)		
Battery	9V, primary alkaline, IEC 6LR61 (or 6LF22)		
Indicators	Four-line LCD display (128 x 32 pixel); dual-colour LED		
Alarms	Occlusion/ syringe empty	Pump paused too long	End program
	Low battery	End battery	Syringe displaced
	Pump unattended		
Dimensions	169 x 53 x 23mm		
Classification	Type CF Equipment (degree of protection against electrical shock)		
Housing	ABS (fire retardant) IPX3		
Weight	210g (without battery)		
Electrical safety	Complies with EN 60601-1 (Medical Electrical Equipment Safety); IEC 601-2-24 (Infusion Pumps and Controllers); IEC 601-1-4 (Programmable Electrical Medical Systems)		
Standards	Manufactured in accordance with ISO 9001:2008 and ISO 13485:2003. CE-marked in accordance with Medical Devices Directive 93/42/EEC		
Electromagnetic compatibility (EMC)	In compliance with EN 60601-1 (Safety) and IEC 601-1-2 (EMC)		
Transportation and storage conditions	Temperature	-25°C to +50°C (-13°F to +122°F)	
	Humidity	5% to 100% RH, non-condensing	
	Air pressure	48kPa to 110kPa	
Operating conditions	Performance specifications may not be met if operated outside of the following conditions:		
	Temperature	+15°C to +45°C (+59°F to +113°F)	
	Humidity	20% to 85% RH at +40°C, non-condensing	
	Air pressure	70kPa to 110kPa	

Safety

SYSTEM SYMBOLS

The following symbols are used on the T34 syringe pump and its components. Labels on the system or statements in this manual preceded by any of the following words and/or symbols are of special significance, and are intended to help you operate the pump safely and efficiently.



Attention, consult accompanying instructions



CSA mark



CE mark; indicates conformance to Medical Device Directive 93/42/EEC



Do not dispose of in municipal waste. Symbol indicates separate collection for electrical and electronic equipment (WEEE Directive 2002/96/EEC). NOTE: Does not apply to the battery



Do not dispose of battery in municipal waste. Symbol indicates separate collection of battery is required



Level of protection against fluid ingress



The use of single-use disposable components on more than one patient is a biological hazard. Do not reuse single-use disposable components



Type CF applied part



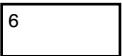
Date of manufacture

SN

Serial number



Expiry date of disposable part



Lot number



Sterilized with ethylene oxide

Document notices



Warning: Indicates that the information is a warning. Warnings advise you of circumstances that could result in injury or death to the patient or operator. Read and understand this manual and all warnings completely before operating the T34 syringe pump.



Caution: Indicates that the information is a caution. Cautions advise you of circumstances that could result in damage to the device. Read and understand this manual and all cautions completely before operating the T34 syringe pump.

NOTE Notes presented in this format highlight additional information or a tip that will help you operate the T34 syringe pump

WARNINGS

To avoid possible personal injury or loss of life, observe the following:



Read the entire Operation Manual before using the pump. The text includes important precautions that should be observed.



The T34 syringe brand detection is based on the physical dimensions of syringes used in the UK during 2006. Some branded syringes are made at multiple sites, however, and may in practice show slight variations. If the T34 does not correctly identify the syringe DO NOT use that syringe, and please promptly notify the T34 manufacturer. Use a visual check to ensure that the volume in the syringe matches the volume indicated on the T34 screen.



Before starting an infusion check that all parameters are set, and especially ensure that calculated parameters are correct. Visually check that the volume in the syringe matches the volume shown on the pump screen and the calculated rate. In the event that the default duration is set to zero, fix the required rate.



The maximum volume that may be infused under single-fault conditions depends on syringe size and brand, and is equivalent to three motor revolutions.



A kinked or occluded IV line may impair the operation of the pump and the accuracy of the infusion. Before operation, verify that the IV line is not kinked or occluded.



Drugs must not be administered to the epidural space unless the drugs are indicated for this purpose. The drugs must be administered in accordance with the manufacturer's instructions.



Epidural administration of drugs other than those indicated for epidural use could result in serious injury to the patient.



The T34 syringe pump should be operated within a temperature range of +5°C (41°F) to +45°C (113°F) and at up to 85% humidity. Operating the pump at temperatures and/or humidity other than within this range may affect accuracy.



Unsafe operation may result from using inappropriate accessories. Use only accessories and options designed for this system and supplied by the manufacturer.



Dropping the T34 syringe pump could cause damage to components. If the pump is dropped, return it for inspection by qualified service personnel.



Use aseptic technique. Patient infection may result from the use of non-sterile components. Maintain the sterility of all disposable components and do not re-use single use IV sets or syringes.



Make sure that only syringe brands that are recognized by the software are used.



When starting a new infusion allow the pump to complete the preloading procedure, as this procedure will assure the correct calculation of the volume in the syringe.

CAUTIONS

To avoid possible damage to the equipment, observe the following:



Do not store the pump with the battery installed.



Should any liquids be spilled on the pump, clean these immediately using a damp cloth or sponge. A mild detergent may be used. Do not use Xylene, acetone or any similar solvent as these could damage the pump. Wipe thoroughly with a dry cloth.



Do not immerse the T34 in any type of liquid, as this could damage the internal components.



Battery damage could occur if the pump is left in a temperature warmer than 50°C.

ELECTRICAL SAFETY COMPLIANCE

The T34 complies with the following standards:

- EN 60601-1 (Medical Electrical Equipment Safety)
- EN 60601-2-24 (Safety of Infusion Pumps and Controllers)
- IEC 60601-1-4 (Programmable Electrical Medical System)
- UL 60601-1 and CAN/CSA C22.2 No 601.1 (Medical Electrical Equipment Safety)

ELECTROMAGNETIC COMPATIBILITY (EMC)

- IEC 60601-1-2 (Electromagnetic Compatibility)

ALARMS

Alarm conditions

Should the pump detect a problem an alarm will be activated and the following will occur:

- An alarm message appears on the display, stating the cause of the alarm and indicating instructions for continued use. The operation LED will light red
- An alarm sounds
- If the unit is infusing the pump will stop the infusion when a alarm is activated.

Alarm types

- Occlusion / Syringe Empty
- Pump Paused Too Long
- End Program
- Low Battery
- End Battery
- Syringe Displaced
- System Error



2

Set Up and Testing

Service information

While under warranty or a service agreement, the T34 syringe pump should only be opened by CME Medical service personnel or on the instruction and agreement of the company. In the event this condition is breached the warranty or contract will be invalidated.

Unless otherwise agreed, the customer is responsible for all shipping costs when returning the pump for service, including times when the pump is under warranty.

The unit must be packed in its original packaging or otherwise in a container that will provide adequate protection during shipping. To assure its prompt service and return, the CME Medical service department must be notified on 01253 894646 before any unit is sent for repair. Reference should be made to any relevant warranty or service agreement or an order number provided, and the serial number of the device should also be provided. A brief written description of the problem or reason for return should be included with the pump.

Failure identification

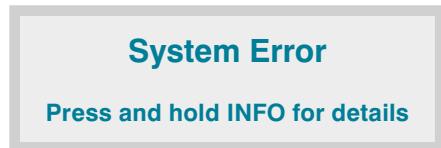
To help identify the conditions and settings at the time of pump failure, users can view a log of the last 512 actions undertaken by the pump.

This Event Log is accessible via Change Set Up on the main menu. The events are displayed in order, beginning with the most recent. The user can scroll through the list by using the Arrow Up key, and can select a specific event to display further information on the pump settings at the time of that event.

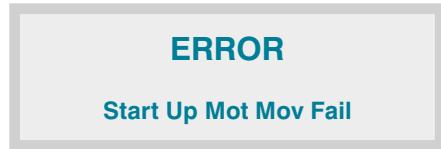
This information may help to determine the nature of the failure, and could be useful in troubleshooting its cause or excluding user error.

SYSTEM FAILURE

If the device fails the unit will be inoperative and the following message will be displayed:



Pressing the Info key will display the error on the device, for example, as follows:



If the problem persists send the pump for service.

Pre-service checklist

Before performing any service procedure the following checks and procedures should be undertaken.

SERVICE PERSONNEL

Service personnel must have training and certification from either the manufacturer or from trainers who are fully authorised by the manufacturer. All service personnel must have the recommended equipment and authorised spare parts on hand to perform the required maintenance procedures or repairs.

DISINFECTION

All pumps must be properly disinfected according to the instructions in the user manual.

CUSTOMER INFORMATION

The document record for each pump should be examined, and it should be confirmed that the pump bears the correct log receipt and serial number. The pump should also be checked for damage or signs of tampering.

EVENT LOG

In cases where a problem has been reported, check the History events to define the frequency and nature of the complaint, and note the program and calibration settings at the times of each recorded event.

Undertake a manual review of pump settings and record the syringe pump settings before beginning service of the unit.

Access the Technician menu and press and hold the Info key and Power button; keeping the Info button pressed release the Power button to display the software version number. This will be followed by the prompt to enter the Technician Code. Enter the code '123' and press Yes/Start to confirm.

Scroll to and perform Main Self-Test. Record any failures or issues identified during the test.

SERVICE DECISION ROUTE

When a T34 syringe pump is returned for service, always ask for a full description of the reasons why the service is being requested. If possible and appropriate, ask for the return also of the administration set in use at the time.

Be mindful of the following factors as part of the service/repair procedure:

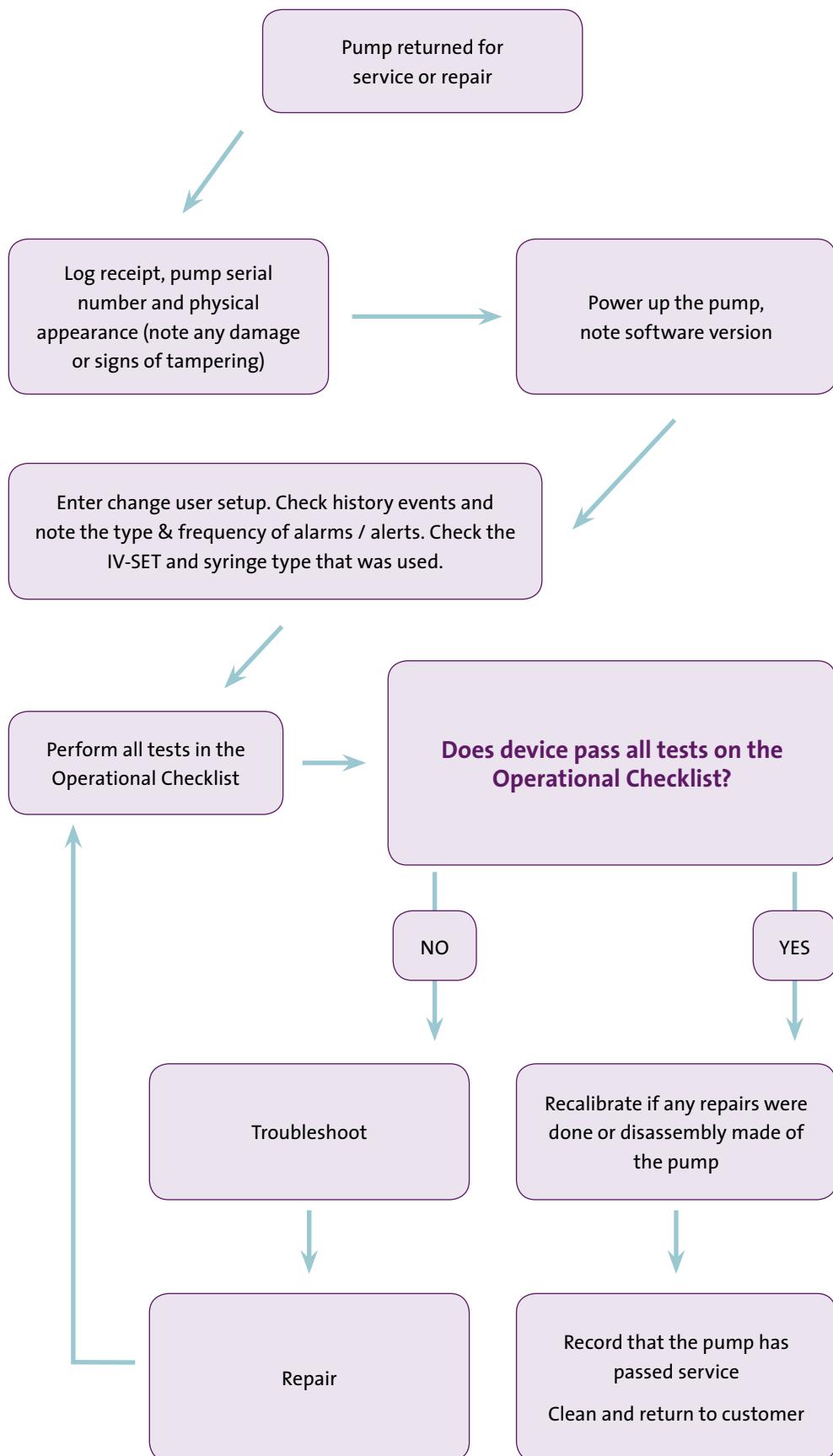
Cross-reference the user's reasons for requesting the service with the event log. Has the user operated the pump correctly? Cross-reference their report with the Operations Manual to

ensure that the steps taken prior to the alarm did not in fact cause the alarm or trigger an error.

Was the fault in one of the pump sensors (identify which one and replace it), or was the fault in one of the circuit boards (identify which PCB failed and replace the board)? Access Technician mode and select either Main Self-Test to run all of the testable options, or select Manual Test to test a specific function.

POSSIBLE ISSUES	CORRECTIVE ACTION
User error	Refer issues back to department lead and suggest training/alerting all users, to prevent the same error being repeated
Fault with syringe or administration set	Check that correct syringe was used. Is the syringe on the list of approved syringes? Is the administration set occluded?
Pump failure	Perform Main Self-Test from Tech menu
Mechanical failure	Change the defective part
Electronic failure	Change the relevant PCB
Failure of sensors: Syringe detection, sensors 1–3	Replace the sensor module

Service process flow chart



Default settings

The T34 pump is programmed with a number of default parameters that can be changed using Change Set Up and, if applicable to the specific version, the Rate setting. These are accessible via the Info menu and Technician menu. Changing them requires the use of an access code.

Some default parameters may be software-dependent. Where a software-dependent parameter is indicated, the applicable range of software versions will also be shown. Generally, the software version sequence is indicated by the software numbers. For example, software version NCAT010110 refers to the first version change (01) accepted on January (01) 2010 (10).

PARAMETER	PURPOSE	DEFAULT	RANGE
Info Menu, accessed by pressing the INFO key. The display will show Info Menu and allow selection of the following parameters			
Battery Level	Current battery level		Empty >> Full (shown as percentage)
Exit	Exit the Info Mode		Press Yes/Start key
Event Log	Last 512 events		Press Info for full disclosure
Rate Setting	Enables the flow rate to be locked in cases where the pump setting gives priority to volume over rate	Access code '5'	On software version NCAT11009C and upwards
Change Set Up	Change default parameters		Enter access code

Change Set Up mode (access with code 99)

Set Time and Date	Ensures all events in log are correctly date and time stamped		Day, month, year; hours, minutes
FF Key Operation	Limits the forward movement of the actuator that results from pressing the FF key during syringe loading	5mm	0.1–100mm
Backlight Duration	Limits backlight duration, to help preserve battery life	5 seconds	0–60 seconds
Info Duration	Limits the length of time the Info screen is displayed	5 seconds	1–20 seconds
Operation LED	Turns off the green flashing operation LED to preserve battery life	32 seconds	Disable; 2, 4, 8, 16, 32, and 64 seconds
Titration Option (on/off)	Allows user to change the operation rate during program	Off	In case default duration is set to zero
Default Duration	When a new program is confirmed the pump resets to this default (setting to zero skips the duration step during programming). When Program Lock is on (see below) this cannot be set to zero	24 Hours	00:01 to 99:00 hours
Occlusion Pressure	Setting at which occlusion alarm will activate	720mmHg	100–1,500mmHg
KVO Operation Rate	Activates Keep Vein Open at end of infusion	Disabled	Enabled/disabled
Program Lock	Prevents alteration of duration or rate during Set Up (with Program Lock on, the default duration cannot be set to zero)	On	On/off
Exit	Enables user to exit Set Up mode		

PARAMETER	PURPOSE	DEFAULT	RANGE / INFO
Technician Mode (access with code 123)			
Serial Number / Production Date	Pump serial number and production date (week, month, and year)	na	
Main Self-Test	Automatically sequences through the following tests: Keypad, Display, Acoustic Alarm, Syringe Sensors, Diameter, Power Voltage	na	
Manual Tests	Allows manual selection from the above tests	na	
Syringe Set Up	Add or delete syringes from the default list	na	See Adding/Deleting a Syringe Procedure in this manual
Pressure Calibration	Pressure calibration routine using the calibrated-force gauges	na	Manufacturing pressure calibration
Factory Pressure Test	Test routine to fine tune the pressure calibrations, using a 5ml and 50ml syringe	na	See above
Pressure Test	Test routine to ensure pressure calibration is within specification	na	
Syringe Travel	Sets up the volume-sensing system by ensuring the CPU knows the position of the actuator	na	See Syringe Travel Calibration in this manual
Diameter Calibration	Sets up the syringe recognition system	na	See Diameter Calibration in this manual. Earlier models of the syringe use two calibration points; newer models (starting from NCAT011009) use three points
Syringe Dead Space	11 mm	11mm	
Volume Test	Can be set to any volume at any flow rate. The test is done by visual comparison between actual volume in the syringe and volume displayed on the pump screen	na	
Factory Settings	Reset all settings to default	na	
Operating Hours	Number of hours in use	na	Reset by pressing the No key
Service Interval	Warning can be set when a preset number of operating hours has been reached	0	0–50,000 hours
Access Codes	Setting the access codes for Technician, Change Set Up, and Rate (defaults are 123, 99, and 5 respectively)	Technician 123 Change Set Up 99 Rate Mode 5	Codes can be changed by the user
Purge Volume	Reduce the start-up time	0.2ml	0–2.0ml (for software versions prior to NCAT011009, maximum purge volume was 0.5ml)
Maximum Rate	Maximum flow rate at which the pump will operate	5ml/h	0.05–650ml/h

ACCESS CODE LIST

The T34 syringe pump has three access codes and a Key Lock feature to prevent tampering with settings and to ensure only authorised personnel have access to these settings. Service technicians need to be familiar with all of these codes.

Code 99 Gives access to the Change Set Up option; allows user to set locking program parameters

Code 123 Provides access to the technician testing and service menu

Code 5 Enables changes to be made to the Rate Setting, via the Info Menu (to change rate mode, default duration needs to be set to zero hours)

Key lock Enables users to lock all keys except the Info and Stop keys, to prevent tampering with the pump

NOTE The codes shown are defaults. They can be changed from within the technician mode, under Access Codes

LOCKING

The T34 provides three types of locking:

- Keypad locking
- Program locking
- Maximal Rate locking

Keypad locking

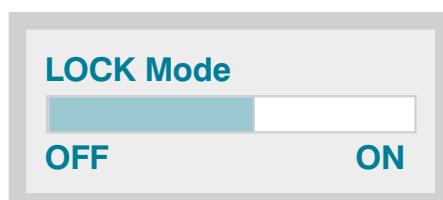
During operation all keys, with the exception of the Stop/No and Info keys, are disabled.



During programming all keys, with the exception of the Start/Yes and Info keys, are disabled.

To lock the keypad, press and hold the **INFO** key until the keypad lock bar graph is filled and a beep is heard. The beep indicates that locking is turned on.

To unlock the keypad, press and hold the Info key until the keypad lock bar graph is depleted and a beep is heard. The beep indicates that locking is turned off.



Program locking

This feature enables the operator to lock the setting keys, so that programs and program parameters cannot be changed once they are set. This option is important as locking the program prevents tampering with the pump parameters.

To lock or unlock the program:

- 1 Press the Info key twice.
- 2 Use the arrow keys to scroll to Change Set Up.
Press Yes/Start to select this option.
- 3 The access code for Change Set Up is 99. Use the arrow keys to set this code. Press Yes/Start to enter.
- 4 Use the arrow keys to scroll to Program Lock.
Press Yes/Start to select this option.
- 5 To lock: The default setting is off. Use the arrow keys to change the setting to on.
To unlock: If the program lock was on, use the arrow keys to change to off and unlock.

Info Menu
Change Set Up
Select ; ↑↓ press YES

Enter Set Up Code 99
Change ; ↑↓ press YES

Change Set Up
Program Lock
Select ; ↑↓ press YES

Program Lock off
Select ; ↑↓ press YES

Maximal Rate locking

This feature enables the operator to set a maximal infusion rate for the pump. The program rate can then be adjusted up to a preset limit.

- 1 Enter Technician menu and press and hold the Info key and the power button. Keeping the Info button pressed, release the power button. The software version will be displayed, followed by a prompt to enter the Technician code.
- 2 Using the arrow keys, set code 123. Confirm by pressing the Yes/Start key.
- 3 Use the arrow keys to scroll to Maximum Rate.
Press Yes/Start to select this option.

Enter Tech Code 0
Change ; ↑↓ press YES

Technician options
Maximum Rate
Select ; ↑↓ press YES

Change Set Up

1 Press the On/Off key to turn on the pump. Press the Info key twice.

2 Use the arrow keys to scroll to Change Set Up. Press Yes/Start to select this option.

Info Menu
Change Set Up
Select ; ↑↓ press YES

3 The access code for Change Set Up is 99. Use the arrow keys to set this code. Press Yes/Start to enter.

Enter Set Up Code 99
Change ; ↑↓ press YES

4 Use the arrow keys to scroll through the set up options and change where necessary.

Change Set Up
Program Lock
Select ; ↑↓ press YES

Table 1 Change Set Up options

CHANGE SET UP OPTION	FUNCTIONAL DESCRIPTION	RANGE
Exit	Select to exit Change Set Up	
Set Time and Date	Allows the operator to adjust the date and time to ensure all logged events are stamped with the correct date and time	
FF Key Operation	Defines the actuator's forward movement distance when the FF key is pressed during syringe loading	0.1–100 mm
Backlight Duration	Defines the duration that the backlight lights up. Can be used to help preserve battery life	0–60 sec
Info Duration	Defines the duration that the Info screen is displayed	0–20 sec
Operation LED	Allows the user to disable or set a time limit on the green LED that indicates the device is in operation. The red warning LED is not affected	Disable; 2–64 sec
*Bolus Maximum Volume	(*Availability of this option depends on software version.) Allows the user to set the bolus maximum volume value or to disable the bolus administration (set to zero, 0)	0–20 ml
Titration Option	Allows the user to enable or disable titration functionality	Enabled/ Disabled
Default Duration	Defines the program's default duration. Set to zero (0), the pump skips the duration step during programming. When the Program Lock is On (see following) the default duration cannot be set to zero	0–99

CHANGE SET UP OPTION	FUNCTIONAL DESCRIPTION	RANGE
Occlusion Pressure	Allows the user to set the pressure at which the occlusion alarm is activated	100–1500 mmHg
KVO Operation Rate	Enables the user to set the Keep Vein Open infusion rate that is to be administered when the program ends	0ml/hr (KVO off) to a maximum of 2ml/hr
Program Lock	Allows the user to set a lock to prevent tampering with the program duration or the rate during set up (with Program Lock on, the default duration cannot be set to zero)	On/Off

Technician menu

To access the Technician menu, press and hold the Info key and power button together. Keeping the Info button pressed, release the power button until the Technician Code prompt appears. The display will show the software version for two seconds before the Access Code prompt. Enter code 123 and press OK.

The pump will display all the parameters that can be set, calibrated or tested. The technician can scroll through all parameters using the arrow keys.

Table 2 Technician menu parameters

MENU ITEM	PARAMETER/OPTION	DESCRIPTION
1	Exit from Technician Mode	Exit Technician Mode
2	Serial Number	Displays serial number and production date
3	Main Self-Test	Runs through keypad, display, alarm sound, syringe sensors test, syringe diameter test, syringe travel
4	Manual Test	Same as Main Self Test but with a menu to focus the user on individual tests
5	Syringe Set Up	Adjusts the default diameter for the list of approved syringes
6	Pressure Calibration	Allows calibration and pressure settings. Manufacturing calibration
7	Factory Pressure Test	Fine tuning of pressure calibrations Service calibration
8	Pressure Test	Tests actual pressure. Occlusion pressure test
9	Syringe Travel	Calibration of syringe movement about 68mm
10	Diameter Calibration	Tests the syringe barrel sensor
11	Syringe Dead Space	Actuator limitation for delivering the entire volume. Manufacturing value does not change
12	Volume Test	Performing volume delivery test

MENU ITEM	PARAMETER/OPTION	DESCRIPTION
13	Factory Setting	CAUTION: pressing Yes/Start will restore factory defaults and delete all pre-set protocols and set up
14	Operation Hours	Hours of use since last service
15	Service Interval	Number of hours before Send for Service message will appear
16	Purge Volume	Set the maximum volume that the user can purge
17	Maximum Rate	Set Rate Limit (0.05–650ml/h)

Enabling and disabling a syringe type in the pump menu

1 Enter Technician menu by pressing and holding the Info key and power button. Keeping the Info button pressed, release the power button. The software version will display, followed by Enter Tech Code.

Enter Tech Code
Change ,↑↓ Press Yes

2 Using the arrow keys, set code 123 and confirm by pressing the Yes/Start key.

3 Use the arrow keys to scroll to Syringe Set Up. Press Yes/Start to select this option.

Syringe Size
2ml
Select ↑↓, Press Yes

4 The pump will display a syringe default size; scroll up or down to the correct syringe size needed. Press Yes/Start to confirm.

Syringe Brand
50/60 Monoject
Select ↑↓, Press Yes

5 Use the arrow keys to scroll through the list of brands to the brand of the syringe needed. Press Yes/Start to confirm.

50/60 Monoject
Syringe Disabled
Refer to Operations
Manual

The display will show a summary of the manufacturer's data for that syringe. Press Yes/Start to confirm and exit Syringe Set Up.

50/60 Monoject
Enable This Syringe?

6b **Disabling:** From the screen in which the summary of the manufacturer's data for the syringe is displayed, press No. When prompted to disable the syringe, press Yes/Start. The Syringe Disabled screen is displayed.

6ml Monoject
Disable This Syringe

Press Yes/Start to exit Syringe Set Up.

6ml Monoject
Syringe Disabled
Refer to Ops Manual

Operational checklist and calibration tests

INTRODUCTION

The Operational Checklist and Performance Acceptance Test detailed in this section must be followed to determine if the T34 syringe pump is operating correctly, and must also be followed before any service work is performed. If the device fails any test in the checklist, the fault must be recorded and corrected prior to placing it back into clinical use. If a test failure occurs, this should be analyzed using the troubleshooting procedure that follows to determine what service action is required. After the service is completed, the checklist should be followed once again and the Performance Acceptance Test repeated. The device should be recalibrated if required.

If the pump is submitted for service as a complaint, it should be tested with all associated products, such as sets, to as far as possible replicate the customer's complaint. Once the complaint evaluation with the associated product(s) has been completed the device should be retested alone in the normal service process.

If the problem cannot be resolved, withdraw the pump from user service and troubleshoot according to the troubleshooting section in this service manual. Alternatively, return the device to the manufacturer for service.

Once a problem has been identified and isolated to a single assembly, the assembly should be replaced in accordance with the disassembly procedures provided in this manual.

ROUTINE PREVENTIVE MAINTENANCE

- At least once a month, or as required:

Clean pump housing with a suitable cleaning agent
Check housing for damage and replace any labels that are damaged

- At least every 12 months, or as required:

Perform all tests, including the Functional Test Procedures, and recalibrate if necessary.

Maintenance

The maintenance procedures outlined in this section may be performed in the hospital, by qualified and certified biomedical engineers. If an abnormal condition occurs that cannot be corrected by performing the following procedures, remove the pump from service and troubleshoot in accordance with the troubleshooting table. Alternatively, return the device to the manufacturer or distributor for service.

MAINTENANCE PROCEDURES

The following pages present a list of potential problems that could afflict the T34, and the tests and actions that should be undertaken to identify the nature of a pump malfunction. These actions also should be undertaken routinely as preventive maintenance.

Review this section whenever a condition exists that does not appear to be normal. Perform the specified checks and corrections, and if the problem cannot be resolved withdraw the pump from service.

The following equipment is required:

- New 5ml and 50ml BD Plastipak (or any other brand of Luer lock) syringe
- Water for injection
- 9V primary alkaline, IEC 6LR61 (or 6LF22) battery (not supplied)
- Pressure gauge
- Three-way tap
- Digital vernier calliper or Absolute Digimatic Indicator ID-U (where volume testing is required)

Preventive maintenance & functional test procedures

Technician Code = 123; Change User Set Up = 99

1 PRINT PUMP SETTINGS

Where these are available, you can use Bodycomm and a docking station to print the pump settings on a CME T34 PPM Data Sheet (a copy is located at the end of this document).

2 VISUAL CHECK

Check the pump housing for physical damage. Using a brass pencil brush, clean the drive screw and the slide rails of any debris or contaminants.

3 SYRINGE RECOGNITION AND VOLUME DETECTION TEST

Equipment required

- T34 syringe pump
- Samples of each of the Luer lock syringes that are used with the pump

Method

Switch on the pump and allow preloading to complete. For most syringes the position of the carriage is not important, but if a smaller syringe is being used the actuator may move beyond the fully extended size of the syringe. If this is the case use the FF key to move the actuator to the desired position. FF key movement is limited for safety reasons, so repeated presses may be necessary.

For each of the syringes:

- 1 Lift the barrel clamp arm and place the syringe on the pump as described in the Operations Manual, ensuring that the collar/flange and plunger are positioned correctly. Place the barrel clamp arm down on top of the syringe barrel.
- 2 The LCD screen should show the Load Syringe message, and after a few seconds the brand and volume. Should the syringe graphic flash or a warning message appear, check the loading of the syringe and ensure that it is correctly positioned.
- 3 The pump should always display the correct volume, but may not always show the correct brand. Use the arrow keys to scroll through the list of syringe brands (pump shows those within $\pm 3\%$ diameter of the one loaded). Select the correct syringe brand and press Yes to confirm selection.
- 4 Read the volume on the syringe and compare it with the volume indicated by the pump. The volume shown on the pump should be within 2% of the actual volume; if it is not, take the following steps:
 - a Check that there is no slack in the system (visible space in the seating of the plunger or the collar/flange). If there is, a purge of the pump may be required and the test repeated. Refer to the Operations Manual.

- b Recheck that the syringe loaded is the same brand as selected at step 3.
 - c If the error remains outside of specification, the pump has failed the test and corrective action is required. Refer to Syringe Calibration in this service manual.
- 5 Repeat steps 1–4 above to recheck.

4 MAIN SELF TEST

Enter Technician menu by pressing and holding the Info key and power button. Keeping the Info button pressed, release the power button. The software version will display, followed by the prompt Enter Tech Code.

Scroll down and select Main Self Test. This will verify that all systems are functioning correctly. If any of these tests fail, the pump will need to be repaired or calibrated.

Main Self Test cycles through the following tests:

- 1 **Keypad Test.** Each key displayed needs to be pressed.



- 2 **Display Test.** The LCD will flash; press Yes to continue.
- 3 **Acoustic Alarm Test.** Buzzer will sound.
- 4 **Syringe Sensors Test.** Follow instructions on pump display.
- 5 **Syringe Diameter Test.** Insert a syringe of known diameter. Tolerance is $\pm 0.2\text{mm}$.
- 6 **Syringe Travel Test.** The actuator will run to the front of the pump, to the back, and then again to the front.
- 7 **Battery Voltage.** This test measures the voltage across the battery terminals, to a tolerance of $\pm 0.1\text{V}$.

If any of the tests fail in the main self testing, refer to trouble shooting guide and calibration procedures in this service manual.

5 OCCLUSION TEST

Equipment needed

- New 5ml & 50ml Luer lock syringes, filled with water for injection
- Pressure gauge with three-way tap

T34 unit set up to test at 540mmHg

- 1 Prepare the 5ml syringe and infusion set by attaching the infusion set to the syringe and manually priming it to eliminate air from the system.
- 2 Switch the pump on in Technician menu. Scroll down to Pressure Test.
- 3 Connect the syringe to the pressure gauge assembly (*see below*).



- 4 Position the carriage to fit the syringe using the FF or Back key.
- 5 Lift the barrel clamp arm and load the syringe. Use the scroll keys to select the correct brand from the list (as described in the Operations Manual). Press Yes to confirm selection.
- 6 Press Yes to start the test. With the three-way tap open let out a few drops, then close the tap.
- 7 The pressure will be displayed on the LCD. This should be seen to rise.
- 8 The pump will display the pressure on the LCD at which it has alarmed. Check that the occlusion alarm operates within a $\pm 160\text{mmHg}$ tolerance range.

Repeat the above procedure for the 50ml syringe.

If the unit is out of specification, please refer to pressure calibration procedures.

NOTE When doing an occlusion pressure test, you **MUST** use a new syringe. The use of an old syringe can affect the results. Other variants that can affect results include line constrictions, use of a viscous fluid, and a high flow rate.

Do not use an IDA device to test occlusion pressure, as results can be erratic.

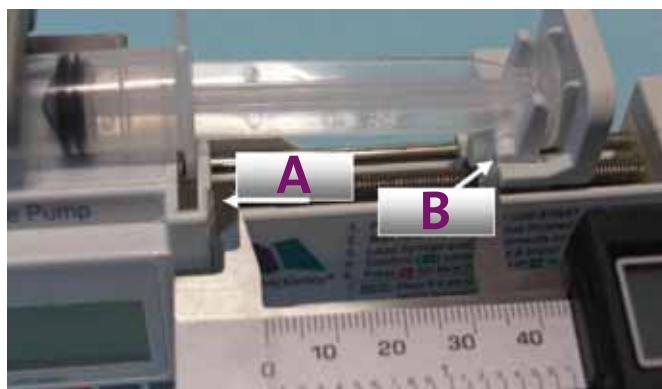
6 VOLUME TEST

Equipment needed

- New 5ml BD Plastipak Luer lock syringe
- Digital vernier calliper

Linear accuracy test using dry testing

- 1 Switch the pump on in Technician Mode.
- 2 Scroll to Volume Test.
- 3 Load a 5ml BD Plastipak Luer lock syringe with 4.5ml of air onto the pump.
- 4 Before selecting the syringe use the FF key to advance the syringe to the 4ml mark.
- 5 Select 5ml BD Plastipak.
- 6 Using vernier callipers measure the distance between Point A and Point B (*below*)



- 7 Set the rate to 10ml/h.
- 8 Set the volume to 2ml.
- 9 Allow the pump to deliver the 2ml.
- 10 When the pump has stopped (12 minutes), measure the distance between point A and point B again.
- 11 Subtract the second measurement from the first measurement.
- 12 To pass the test the result should be 17.4mm \pm 2% (ie, in the range 17.05–17.75mm).

If volume testing fails, refer to syringe travel calibration procedures in this service manual.

NOTE When doing an volume test you must take into account the tolerance of the pump (\pm 2%) and that of the syringe (\pm 4% for a BD syringe, for example).

Only use a Luer lock syringe. A Luer slip syringe will produce a volume delivery error.

Calibrations

T34 PRESSURE CALIBRATION

- 1 Set Occlusion Alarm to 540mmHg in Change User Set Up.
- 2 Enter Tech Mode and scroll down to Factory Pressure Test. Press Yes

Factory Pressure Test

Load Syringe

- 3 Load a 5ml syringe, loaded with water. Select the correct brand and press Yes. Connect the syringe to a pressure gauge with three-way tap open and press Yes. The zero value should display.

NB: Zero level might not always be 0mmHg.
Due to the drag coefficient of the syringe a small pressure value may be displayed.

Zero Level

0mmHg

- 4 Close the connection on the three-way tap and press Yes. The pump will continue to drive the syringe and the pressure should be seen to rise on the gauge and on the pump display.

Zero Level
0 mmHg
Connect & Press Yes

- 5 When the pump thinks it has reached 540mmHg (± 16 mmHg) it will alarm and the display will read as per the example. Take the reading off the pressure meter when the unit bleeps, this is the peak occlusion value.

EXAMPLE: With the occlusion pressure setting at 540mmHg, a reading between 380mmHg and 700mmHg is within tolerance. The unit has passed and is within specification.

5ml BD Plasticpak

540mmhg

540mmHg
Zero Level Sensitive
7 (8) 80

- 6 If the reading between the pump and the gauge is different you should adjust the Zero and Sensitive Levels by pressing the +/- buttons on the keypad.
- 7 First, if the pressure reading is too high, reduce the Zero level. If it is too low, increase the zero level. Press the Yes key once to accept the adjustment.
- 8 Adjust the Sensitive level in the same way.
- 9 Adjusting these two levels will either increase or decrease the occlusion alarm.
- 10 Pressing Yes again will repeat the steps 2 to 4.
- 11 Once the two readings are within the tolerance of ± 16 mmHg, remove the 5ml syringe. Reload with a 50ml syringe, loaded with water, and repeat steps 2 to 4.

PRESSURE TEST

To confirm that the pressure calibration is successful, you should perform the Pressure Test routine, as follows:

- 1 In Technician Mode, scroll to Pressure Test and press Yes.
- 2 Load any test syringe, filled with water, and connect the syringe to a pressure gauge with the three-way tap closed. Press Yes.
- 3 Select the correct brand of syringe and again press Yes.
- 4 The pump will drive the syringe and the pressure should be seen to rise on the pump display and the pressure gauge. The pump will beep when the test has finished.
- 5 Check the pump display against the pressure gauge to ensure that the results are within specification ($\pm 16\text{mmHg}$).

NOTE If you set your 5ml syringe above 540mmHg, your 50ml syringe should fall within specification.

If you have problems calibrating the pressure clean the lead screw. If problems persist replace the complete block assembly.

NOTE The Zero Level data will remain in the pump memory until changed by the user. We recommend that you repeat this procedure once a year.

SYRINGE TRAVEL CALIBRATION

Calibration of the actuator position.

- 1 Enter Technician Mode by simultaneously pressing and holding the Info key and the power button. When the software version displays release the power button. After a few seconds the access code prompt will appear; set code 123 and confirm by pressing Yes.
- 3 Use the arrow keys to scroll to Syringe Travel. Press Yes to select this option.
- 4 Follow the prompt and press the FF key. (If a syringe is loaded, you will be prompted to remove it first.)

Enter Tech Code
123
Change ↑↓, Press Yes

Press FF key

- The actuator will move forward, indicating Locating Min. Travel. When it reaches the end and the display changes to Confirm Min. Travel, check that the actuator is touching the housing. Press Yes, and following the prompt press the Back key. After locating maximum travel, wait until the actuator reaches the other end completely and then press Yes to confirm and continue. You will receive another prompt to press the FF key; after the actuator reaches the front once again, confirm the minimum travel to continue.
- The travel information at the end, which is applicable to the specific pump, serves as a confirmation that the syringe travel calibration completed successfully. The travel should be between 67mm and 68.5mm. Press Yes to exit the procedure.

**Confirm max travel
Press Yes to continue**

**Travel 67.8mm
Press Yes to continue**

SYRINGE DIAMETER CALIBRATION

The pump recognizes syringes by their outer diameter, measuring the diameter with a slide potentiometer and matching this to the closest syringe. We will calculate three diameter points (8mm, 19mm and 30mm) in case the potentiometer is non-linear.

- Enter Technician Mode by simultaneously pressing and holding the Info key and the power button. When the software version displays release the power button. After a few seconds the access code prompt will appear; set code 123 and confirm by pressing Yes.
- Use the arrow keys to scroll to Diameter Calibration. Press Yes to select this option.
- Follow the prompt to set the barrel clamp to the down position. Press Yes to continue.
- Follow the prompt to set the barrel clamp to the upper position (255). Press Yes to continue.

**Enter Tech Code
123
Change ↑↓, Press Yes**

**Locate barrel clamp to
down position
0
Press Yes to continue**

**Locate barrel clamp to
upper position
255
Press Yes to continue**

- Follow the prompt and load an 8mm-diameter jig. Verify detection is correct ($\pm 0.2\text{mm}$) and press Yes to confirm. If the value displayed is incorrect, use the arrow keys to change to the correct syringe diameter and then confirm.

**Load 2-5ml syringe
Diameter 8 mm
Change ↑↓, Press Yes**

- 6 Follow the prompt and load the 19mm-diameter jig. As in step 5, verify detection is correct ($\pm 0.2\text{mm}$) and press Yes, or use the arrow keys to change to the correct syringe diameter and then proceed.

**Load 10-20ml syringe
Diameter 19mm
Change $\uparrow \downarrow$, Press Yes**

- 7 Load the 30mm-diameter jig and proceed as in steps 5 and 6.

**Load 35-50ml syringe
Diameter 30mm
Change $\uparrow \downarrow$, Press Yes**

- 9 This procedure calibrates only one syringe; the pump adjusts the dimensions automatically for all others. Press Yes to finish and exit procedure.

**Syringe Diameter Test
30mm
Press Yes to continue**

NOTE The number of calibration steps depends on the software version – there are versions which require two diameter calibrations and not three. If only two diameter calibration tools are required, the tolerance of the diameter is $\pm 0.5\text{mm}$.

Repeat the procedure until all the jig dimensions are detected correctly. Press the No key to repeat the procedure.

The calibration jigs can be purchased from CME Medical, part number MCK40.

Battery operation

The T34 syringe pump operates on battery power.

NOTE Verify that the battery is in good condition by pressing the Info key during Program Set Up or operation. Press the Info key twice to display battery status.

There are two battery alarm conditions, Low Battery and End Battery:

- 1 The pump will warn that the battery is low before the End Battery alarm activates around 6V.
- 2 When the battery is depleted, the pump will cease operation and the End Battery alarm will be activated around 5.8V.
- If the battery runs out, 'End Battery' appears on the display and the pump stops the infusion. The user cannot restart the pump until the battery is replaced with a new one.

Low Battery

End Battery

The T34 also has a lithium CR1220 3V battery on the motor PCB, which keeps the time and date data on the event log. This should be replaced every four years, but should also be checked annually. If found to be rated at less than 3V it should be replaced.

CLEANING

Before connecting the pump to a patient, and periodically during use, clean the unit using a lint-free cloth, lightly dampened with warm water and a mild detergent or disinfectant.



Warning: Always turn the pump off, and remove the battery before cleaning.



Warning: Where applicable, always unplug the docking station from AC power before cleaning.



Caution: Do not clean the pump or docking station with chemicals such as Xylene, Acetone or similar solvents. These chemicals can cause damage to plastic components and paint. Use a lint-free cloth dampened with warm water and a mild detergent or disinfectant.



Caution: Do not soak or immerse any part of the pump or docking station in water.

STORAGE

If the pump is to be stored for an extended period it should be cleaned and the battery removed. Store in a clean, dry atmosphere at room temperature. Use the original packaging for protection.

User Mode functional testing (normal operation mode)

The following procedure can be performed before and after a service to check the user functionality of the device.

- Syringe Recognition and Volume Detection
- Volume Delivery/Program Nearly Complete
- Infusion/Syringe Displaced Alarm
- Occlusion Alarm

Before changing any settings we recommend that you create a macro of your pump settings (if you have a docking station available, refer to the Bodycomm instructions in this service manual on creating a macro).

Make sure you have the relevant syringes enabled on your device. Again, creating a test macro with the test syringes enabled would be an advantage.

NORMAL OPERATION MODE CHANGE USER SET UP 99

- 1 Switch on the device and wait for the preload to complete.
- 2 Remove the program lock and set default duration to 0.00 hours. Ensure that any settings changed are changed back at the end of the testing.
- 3 Press the Info key, scroll to Change Set Up, and press Yes.
- 4 Enter the code 99 and press Yes. Scroll to Program Lock, and press Yes to confirm selection.
- 5 Use the arrow keys to change the Program Lock status from On (default) to Off. Press Yes to confirm change.
- 6 Change default duration to 0.00 hours.
- 7 While Program Lock is displayed, scroll to Default Duration and confirm the default at 0.00 hours by pressing Yes.
- 8 Scroll down to Exit and press Yes to leave the Set Up menu. Load Syringe will be displayed; switch the pump off.

1 SYRINGE RECOGNITION AND VOLUME DETECTION

- 1 Switch the pump on and allow preloading to complete.
- 2 Lift the barrel clamp arm and place the syringe on the pump as described in the Operations Manual, ensuring that the collar/flange and plunger are positioned correctly. Place the barrel clamp arm down on top of the syringe barrel.
- 3 The LCD screen should show the Load Syringe message, and after a few seconds the brand and volume. Should the syringe graphic flash or a warning message appear, check the loading of the syringe and ensure that it is correctly positioned.
- 4 The pump should always display the correct volume, but may not always show the correct brand. Use the arrow keys to scroll through the list of syringe brands. Select the correct syringe brand and press Yes to confirm selection.
- 5 Read the volume on the syringe and compare it with the volume indicated by the pump. The volume shown on the pump should be within 2% of the actual volume; if it is not, take the following steps:
 - a Check that there is no slack in the system (visible space in the seating of the plunger or the collar/flange). If there is, a purge of the pump may be required and the test repeated. Refer to the Operations Manual.
 - b Recheck that the syringe loaded is the same brand as selected at step 3.
 - c If the error remains outside of specification, the pump has failed the test and corrective action is required. Refer to Syringe Calibration in this service manual.

2 VOLUME DELIVERY FOR TESTING THE PROGRAM NEAR END ALARM

Required equipment:

- 5ml syringe filled with water for injection
- T34 extension set

- 1 Switch the pump on with barrel clamp arm down and allow preloading to complete.
- 2 Put 2ml of water in the 5ml syringe, and attach an extension set.
- 3 Using the cursor keys, position the actuator to fit the syringe.
- 4 Lift the barrel clamp arm and load the syringe. Use the arrow/scroll keys to select the correct brand (refer to the Operations Manual for more information) and press Yes to confirm.
- 5 A rate of zero will be displayed. Using the cursor keys, increase the rate to the maximum default rate of 5ml/h and press Yes to confirm.
- 6 The infusion summary will be displayed.
- 7 If required, purge the system by pressing the FF key to ensure all the slack is taken up (if purge is enabled, the default purge is 0.2ml).

- 8 Press Yes to confirm. The display will show Start Infusion; press Yes again and infusion will start and the following screen messages will be displayed:



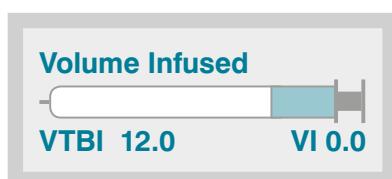
- 9 The 'Program Nearly Complete' alarm will sound; depending on the syringe size, as the infusion nears either 15 minutes or 15mm to program end. The message will repeat every 15 seconds.
- 10 The 'End Program' alarm will sound when the 2ml has been fully delivered.
- 11 Press Yes to confirm End Program. Check that the time predicted to End Program corresponds to the actual operation time.

3 INFUSION TEST/SYRINGE DISPLACED ALARM

This test checks that the pump does not exhibit alarms or errors during normal operation.

- 1 Switch the pump on using the On/Off key. Allow preloading to complete – this ensures correct detection of the volume in the syringe.
- 2 Load a syringe (refer to the Operation Manual for the list of syringe brands configured for use with the T34). Verify that the pump detects the syringe correctly and press Yes. If an incorrect syringe is named, use the arrow keys to select another brand of the same size. A summary screen will be displayed followed by the volume; verify and press Yes to confirm.
- 3 A rate of zero will be displayed. Using the cursor keys, increase the rate to the maximum default rate of 5ml/h and press Yes to confirm.
- 4 Check the data on the screen and press Yes to confirm.
- 5 Start Infusion will be displayed. Press the Yes key to begin.
- 6 If the pump stops infusing and reports an alarm, refer to the Troubleshooting section for the list of alarms and events during operation. To restart infusion, press Yes.

NOTE Pressing the Info key during operation will display the total volume to be infused and the infused volume. Pressing the Info key twice will display the battery status. In each case the screen will display for 7 seconds.



Syringe Displaced Alarm

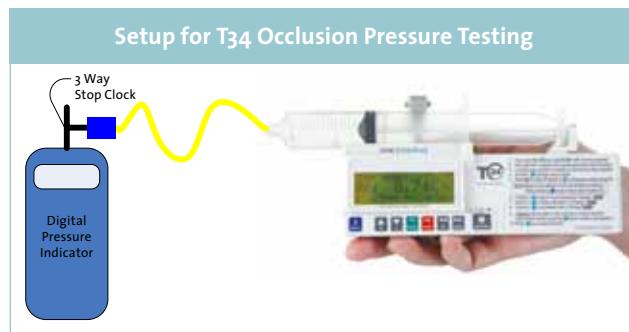
While the unit is infusing, move the barrel clamp arm into the up position. The alarm will sound and the message on the display will read 'Syringe Displaced, Check Syringe'. Press Yes and the following will be displayed: 'Check Syringe Loaded Correctly'.

Place the barrel clamp arm back into the correct position and press Yes. The syringe brand will be displayed; select the correct size and brand and press Yes to resume.

4 OCCLUSION ALARM

Required equipment:

- Syringe filled with water for injection
 - Pressure meter with tubing and a three-way tap
- 1 Switch the pump on and allow Preloading to complete. Reposition the actuator if necessary using the FF or BACK key.
 - 2 Load the syringe with a pressure meter connected. The three-way tap should be closed.
 - 3 If the device shows the message 'Press Yes to Resume, No for New Syringe', press No. The volume is not relevant for this test so press Yes to confirm the volume detected.
 - 4 A rate of zero will be displayed. Using the cursor keys, increase the rate to the maximum default rate of 5ml/h and press Yes to confirm.
 - 5 The summary screen will be displayed. Press Yes twice to start infusing.
 - 6 Monitor the pump. As soon as the T34 alarms the anti-bolus system will come into operation, causing the pump to reverse. The pressure should almost immediately fall to a safe level to prevent post-occlusion boluses to the patient. The actuator will reverse either to about 1.6mm or to the beginning of the program point, if, before the alarm, the distance was less than 1.6mm.
 - 7 There is a tolerance of $\pm 160\text{mmHg}$ on the occlusion pressure. If the device is out of specification, please refer to calibration procedures.



NOTE When doing an occlusion pressure test, you **MUST** use a new syringe. The use of an old syringe can affect the results. Other variants that can affect results include line constrictions, use of a viscous fluid, and a high flow rate.

Do not use an IDA device to test occlusion pressure, as results can be erratic.

Alarm Tests

ALARM	WHEN ACTIVATED AND WHERE TESTED
Syringe Displaced	Test while the T34 is infusing: Remove the syringe from the pump, the alarm is activated and a screen message describes the cause.
Occlusion/Syringe Empty Near End	Pump has sensed a pressure above the alarm level. Possible causes: Occlusion or actuator has reached end of travel/syringe empty. Alarm activated when pump is either 5mm or 2 minutes from end of infusion. The larger value of the two. Tested during Volume test
End Program Pump Paused too Long	The set Volume to be Infused has been infused. Test while the pump is displaying any setting screen. No key was pressed for 2 minutes.
Low Battery End Battery	Alarm activated when the battery voltage drops around 6V. Alarm activated when the battery voltage drops around 5.8V.

- 8 Test completed, turn the pump off.

5 RESETTING THE SERVICE INTERVAL AFTER A SERVICE

- 1 Enter Technician Mode 123 and press Yes. The serial number will be displayed.
- 2 Scroll to Service Interval and select Yes. The interval to the next service will be displayed in hours; pressing Yes again will display the interval in months. Enter the interval that you require and press Yes to confirm.
- 3 After you have entered the required service interval, you will need to reset the operating hours. Scroll through the Technician menu until you reach Operating Hours and press Yes to select. The summary screen will be displayed; press No to reset. Enter the required time and press Yes to confirm.

The service interval has now been set up on your device.

6 RESTORE PROGRAM LOCK AND ALL PARAMETERS

After all tests have been performed, follow the procedure below to restore the program lock and default duration to 24:00 hours (this assumes that this is the preferred configuration of your site's devices).

- 1 Switch the pump on and allow Preloading to complete.
- 2 Press the Info key and scroll to Change Set Up. Enter code 99 and press Yes to confirm.
- 3 Scroll to Program Lock. Use the arrow keys to change the setting from Off to On and press Yes to confirm.
- 4 Scroll to Default Duration and use the arrow keys to change the duration to its original default, 24:00 hours.
- 5 Scroll to Exit and press Yes. The LCD displays the flashing syringe graphic.
- 6 Turn the pump off.

Sample service sheet

CME T34 PPM Data Sheet vr1		
Customer or Serial number		
Accessories included	Box Pouch	Ops Man. Lockbox
2. Visual Inspection	Pass	Fail Give details
Initials		
3. Syringe Recognition and Volume Detection Test		
Initials		
4. Main Self Test	Pass/Fail	
Key Pad Test		
Display Test		
Acoustic Alarm Test		
Syringe Sensors Test		
Syringe Diameter Test		
Syringe Travel Test		
Battery Voltage	Displayed	v
	Measured	v
Initials		
5. Occlusion Pressure (Displayed Pressure ±160mmHg) mmHg		
6. Volume Test	%	Error
7. Alarm Test		
Reset Factory Settings (if required)		
Bodycomm		
Load Global Macro (if required)		Initials
Clean Casing		Initials
Attach Labels		

Parts Used				
Part Num.	Description	Lot Num.	QTY	Reason

3

Pump assembly



Introduction

This section of the manual includes a list of tools and test equipment required for the maintenance and replacement of sub-assemblies.

To ensure the device is operational, make sure you complete the procedures in this section and fill in the operational checklist.

TOOLS AND TEST EQUIPMENT

The following tools and test equipment are required to perform the procedures contained in this section. Since all fasteners on this device are metric, ensure that all tools used are for metric fasteners.

- Multimeter
- 3mm Phillips screwdriver
- Pressure meter with tubing and a three-way tap
- Anti-static mat / Anti-static work surface
- Small utility knife
- Flat 3mm screwdriver
- Allen angled wrench/spanner, 1.5mm
- 4mm open wrench/spanner
- Anti-static tweezers
- Metric feeler gauge (for 0.05–1.00mm)
- Thread-locking glue (eg, OmniFIT M50)
- Silicone (engineering adhesive sealant)
- Soldering iron
- Solder wire, rosin core 0.6mm
- Small-diameter test bars (8mm)
- Medium-diameter test bar (19mm)
- Large-diameter test bar (30mm)*
- Optional: Cutting pliers, needle-nose pliers, 1.5mm ball-point allen wrench/spanner

* Only for software versions with three diameter-calibration points.

Pump assembly and disassembly

Disassembly of the T34 syringe pump is limited to its mechanical components. Electrical problems should be corrected by the replacement of the malfunctioning printed circuit board (PCB) (main, encoder, motor, or rear PCB) unless circumstances warrant component repair. Use only replacements from the replacement parts list.

The disassembly/assembly procedures detailed in this manual are:

- 1 Separation of front and rear housing
- 2 Replacement of motor and pumping block
- 3 Replacement of main and motor PCBs
- 4 Replacement of pump motor
- 5 Replacement of rear PCB

Make sure you read all steps in the procedure before you begin to disassemble the device. The procedures are given in order of disassembly. Disassemble the device only as far as needed to complete the repair. All fastening components such as screws, washers and nuts used in the device are metric; use only metric tools and replace only with metric components.

NOTE Ensure all gasket material is put back in place during reassembly.

1 SEPARATION OF FRONT AND REAR HOUSING

Turn the device off and place it face down on an anti-static mat or a soft work surface. To avoid scratching the pump housing, make sure there are no metal parts on the work surface.

Remove the battery from the battery compartment at the rear of the device (Figure 1).



Figure 1. Battery removal

Remove the six mounting screws that connect the front and rear housings. Five are located in the rear housing of the pump and one beneath the battery cover (Figure 2). All six screws are size M2.



Figure 2. Rear housing screw assignments

Stand up the device and separate the front and rear housing (Figure 3).

NOTE The front and rear housing cannot be separated if the actuator is located at either of the ends of the housing. Rotate the syringe screw manually to move the actuator from its distal location (Figure 4).



Figure 3. Separating front and rear housing

Reassemble the housing in the reverse order. Make sure the front and rear housing surfaces are lined up parallel to one another and that the connectors are mating properly, and then press them together and secure the screws as described in Figure 2.

If when pressing the front and rear housing parts together there is an obstruction in the middle, rotate the actuator screw manually (Figure 4, b) to move the actuator from the edge, where it is tight against the housing (a), to a location in which there is no overlap between the actuator and the housing (c).



Figure 4. Repositioning the actuator

Insert the six mounting screws and tighten them to 0.15Nm with a calibrated torque screwdriver. Note that the respective screw sizes are as depicted in Figure 2.

After reassembling, turn the pump on and check that the self-test and preloading procedures are performed correctly.

2 REPLACEMENT OF MOTOR AND PUMPING BLOCK

Separate the front from the rear housing of the pump (see procedure 1, Separation of Front and Rear Housing).

Remove the upper label from the front housing, where the syringe sits, and then remove the fixing screw beneath (Figure 5).

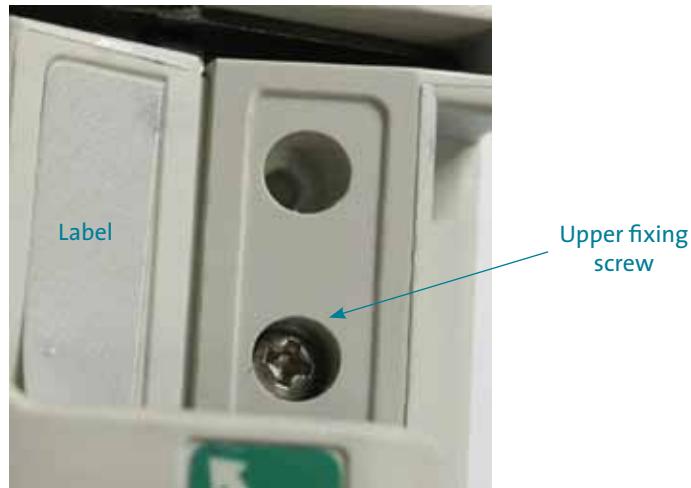


Figure 5. Upper label uncovered fixing screw

Make sure to remove the M2x8 fixing screw from the rear housing (screw #2 in Figure 2).

Disconnect the motor encoder connector on the main PCB (Figure 6).

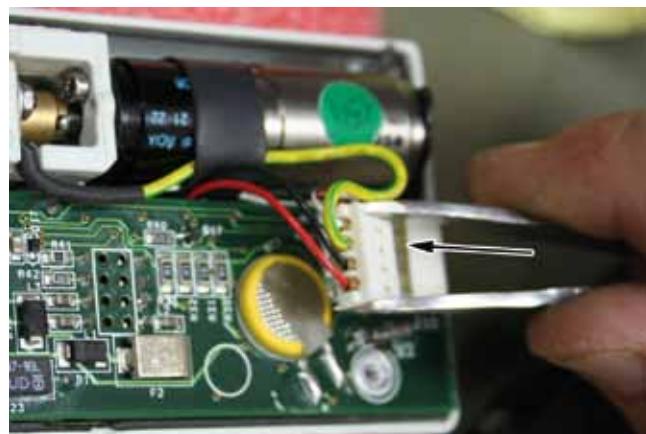


Figure 6. Disconnecting the motor encoder connector

Pull out the block assembly (Figure 7).

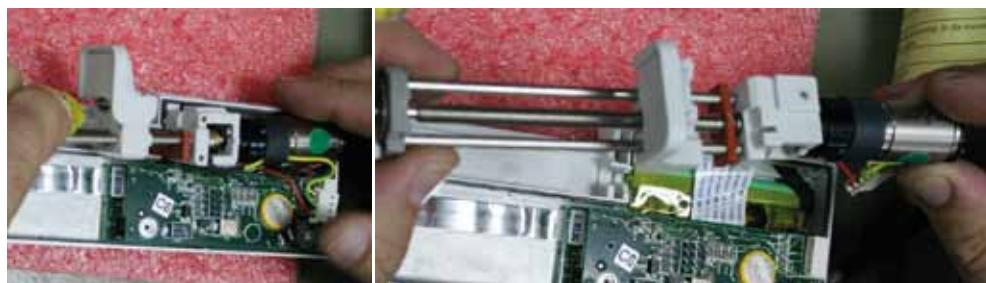


Figure 7. Pulling out the block assembly

Reassemble in the following order:

- a Start by taking the front housing and checking that the LCD display is seated properly within the surrounding plastic confinement and not on top of it. Make sure that the plastic corner of the LCD is level with the surrounding ridge (Figure 8)

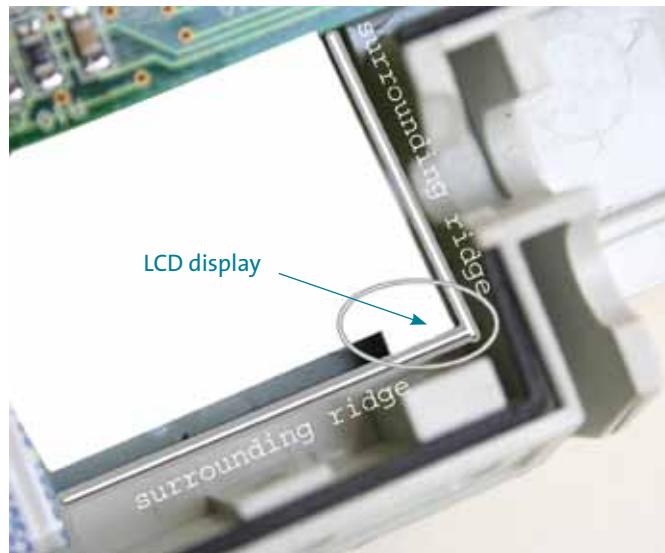


Figure 8. LCD level with surrounding ridge

- b To ensure that the pump block's actuator inserts and turns easily, verify that QF1 and DIL2 on the motor encoder PCB are upright and not tilted (Figure 9).

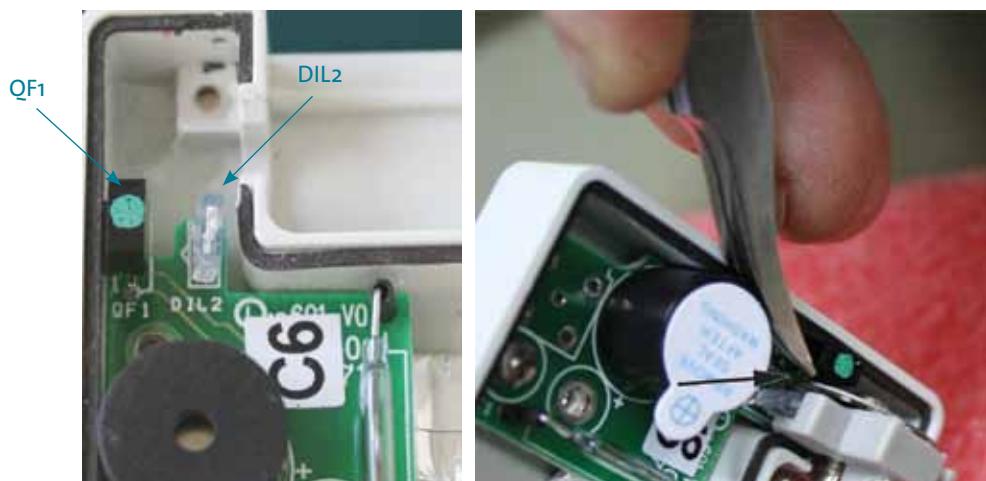


Figure 9. QF1, DIL2 (left), verifying encoder moves easily (right)

NOTE If a new PCB was assembled, remove the seal from the buzzer.
Refer to Figure 15.

- c Insert the block assembly, making sure that the motor encoder wires are inserted between the two PCBs, and not tucked beneath the motor (Figure 10).

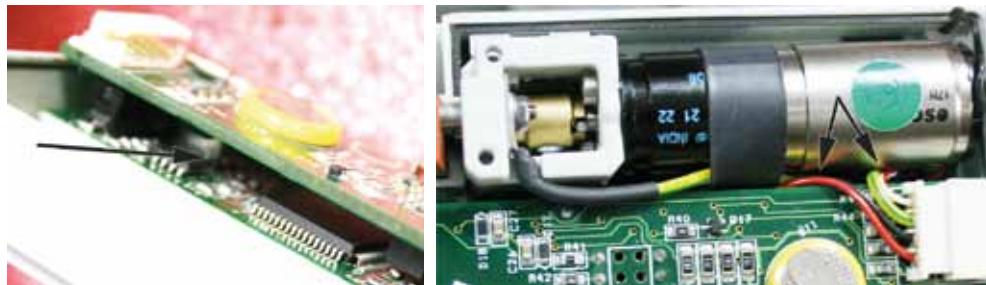


Figure 10. Correct encoder wire location

- d Connect the motor encoder connector (refer to Figure 6).
e Screw in the upper fixing screw and then reattach the upper label to cover the screw.
f Reassemble the front and rear housing.
g After replacing the motor and pump block, the following calibrations are required, as described in the calibration section of this manual:
- Syringe Travel
 - Diameter Calibration
 - Pressure Calibration

3 REPLACEMENT OF MAIN AND MOTOR PCBS

Separate the front and rear housing of the pump as described in procedure 1, Separation of Front and Rear Housing. Remove the block assembly as described in procedure 2, Replacement of Motor and Pumping Block.

Remove keypad label from the front housing and release the two M2x5 spacer screws (Figure 11):



Figure 11. Releasing the spacer fixing screws

Detach the motor PCB (top PCB) carefully, noting the spacers (Figure 12).

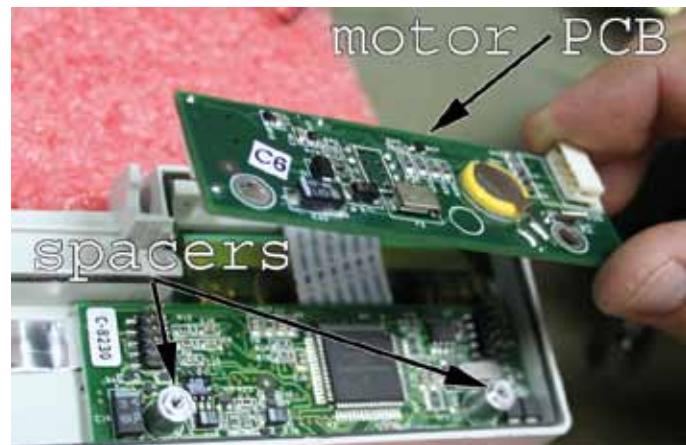


Figure 12. Detaching the motor PCB

Remove the two M2x5 encoder PCB fixing screws. Take care not to harm the reed switch (Figure 13).



Figure 13. Releasing the encoder PCB screws

Lift out the encoder PCB and the main PCB (connected with the flat cable). Disconnect the display's connector from the main PCB (Figure 14).



Figure 14. Disconnecting display from main PCB

NOTE Make sure that the new PCB contains the correct version of the software.

Install a new motor PCB or a new main PCB and reassemble in reverse order, as follows:

- 1 Start by connecting the display connector to the main PCB (Figure 14).
- 2 Check that the LCD is seated properly within the surrounding plastic confinement and is not on top of it. Make sure that the plastic corner of the LCD is level with the surrounding ridge (Figure 8).
- 3 Insert and secure with screws the main PCB and the encoder PCB unit. Two M2x5 screws secure the encoder PCB (Figure 13) and two the main PCB and spacers (Figures 11 and 12). Click to attach the motor PCB to the main PCB. Ensure that you remove the protective seal from the buzzer before replacing the main PCB unit (Figure 15).



Figure 15. Removing protective seal from buzzer

- 4 Insert the block assembly.
- 5 Connect the motor encoder connector.
- 6 Screw in the upper fixing screw and then reattach the upper label to cover the screw.
- 7 Reassemble the front and rear housing. When replacing the main PCB, because some of the calibrations are specific to every pump, the following calibrations are required:
 - Syringe Travel
 - Diameter Calibration
 - Pressure Calibration

Refer to the calibration sections for the calibration procedures. Once done, perform the operation checklist.

D REPLACEMENT OF PUMP MOTOR

Separate the front and rear housing of the pump, and remove the block assembly as described in procedure B, Replacement of Motor and Pumping Block.

Using a #4 open wrench/spanner, remove the nut securing the motor wire connector and detach the wire connector loop (Figure 16).



Figure 16. Required tools (left); and releasing the wire connectors (right)

Using an angled Allen wrench/spanner, remove the two cylindrical head cap screws M2x5 from the front block housing (Figure 17).



Figure 17. Releasing the motor from the block



Figure 18. Separated motor and front block

Separate the motor from the front block (Figure 18).

Reversing the order in which the components were disconnected, install the new motor:

- a Secure the two M2x5 cylindrical head cap screws (Allen screws) that connect the motor to the block (Figure 17).
- b Secure the motor wire connector to the block: place the yellow-green wire loop above the horseshoe washer in the inner side of the block, and secure with a washer and closing nut (Figure 16).
- c Insert a washer on the leading bar on the other side of the block, then place the red-and-white wire loop on the washer and secure by bolting the nut. Secure the screws using a thread-locking glue such as OmniFIT M50 (Figure 19).

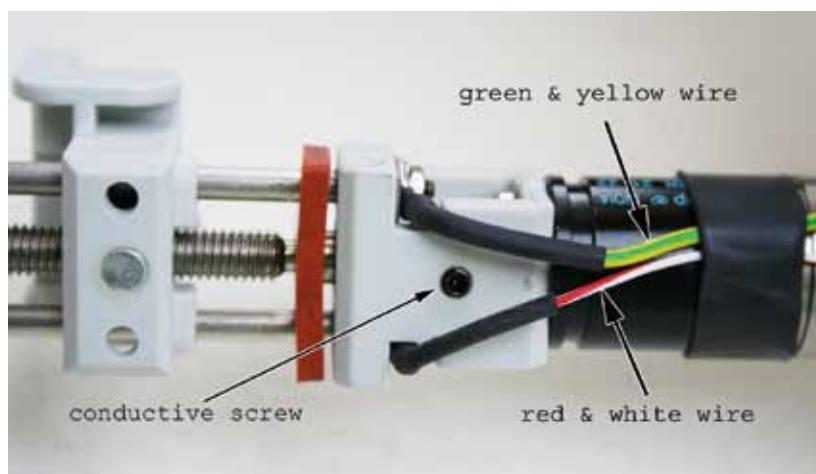


Figure 19. Wiring placements

NOTE Be careful not to release the conductive screw, which creates a magnetic field from the magnet on the motor shaft to the reed switch K2.

- d Insert the reassembled actuator and motor block in the front housing, as described in procedure B, Replacement of Motor and Pumping Block.
- e Connect the motor encoder connector, making sure that the wires are not tucked beneath the motor.
- f Screw in the upper fixing screw and reattach the upper label to cover the screw.
- g Reassemble the front and rear housing.
- h After replacing the motor, the following calibrations are required:
 - Syringe Travel
 - Diameter Calibration
 - Pressure Calibration

Refer to the calibration sections for the calibration procedures. Once done, perform the operation checklist.

E REPLACEMENT OF REAR PCB

Separate the front and rear housing of the pump.

Unsolder the copper contacts on the rear PCB. Be careful not to damage the copper pads beneath the contacts (Figure 20).

Remove the collar sensor and spring locker unit (Figure 21).

Unscrew the three M2x4 screws and remove the M2 plastic washers (Figure 22).



Figure 20. Soldered contacts



Figure 21. Collar sensor with spring locker (left); removal of collar sensor (right)

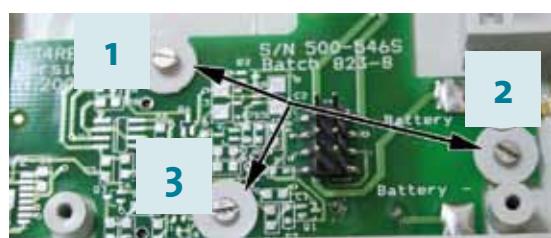


Figure 22. Rear PCB fixing screws with washers

Slightly lift the PCB from the left side and slide it out. Take care not to damage the copper contacts in any way.

Install a new rear PCB and reassemble in reverse order, as following:

- a Place the rear PCB in its correct position in the housing, making sure that the protruding boss of the potentiometer matches its socket in the lower part of the case. Test to ensure that the syringe holder works smoothly (Figure 23).

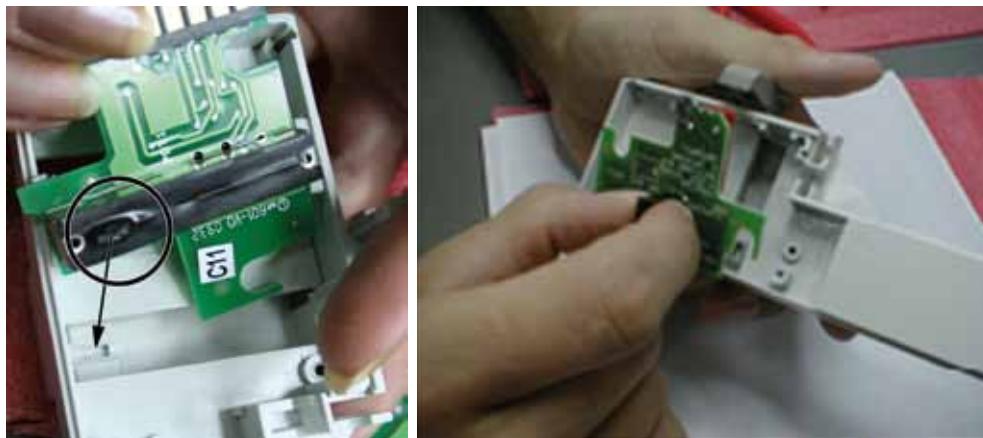


Figure 23. Rear PCB positioning

- b Remove the PCB and apply silicone to the two panels on the potentiometer, then reinsert. Press the PCB in place and keep pressing for a few seconds, then leave for a few minutes to let the silicone dry (Figure 24).



Figure 24. Treating the rear PCB's potentiometer part

- c Put the three M2 plastic washers in place (Figure 22) and screw a slotted cheese-head screw M2x4 through each washer.
- d Apply silicone to fill the gap between the housing and PCB in the area marked with the arrow in Figure 25.



Figure 25. Sealing the gap between the rear PCB and its housing

- e Solder the contacts of the contact wall assembly to the PCB, using a solder iron heated to 350°C, flux solution and 0.6mm rosin-core wire.

- f Fix the collar sensor and spring locker unit in place as follows (Figure 26):
- Insert the collar sensor into the spring (see Figure 21).
 - Insert the spring part into its cavity in the housing wall (a).
 - Insert the collar sensor into its place adjacent to the housing wall (b). Take care not to damage the button of the sensor on the PCB (c).

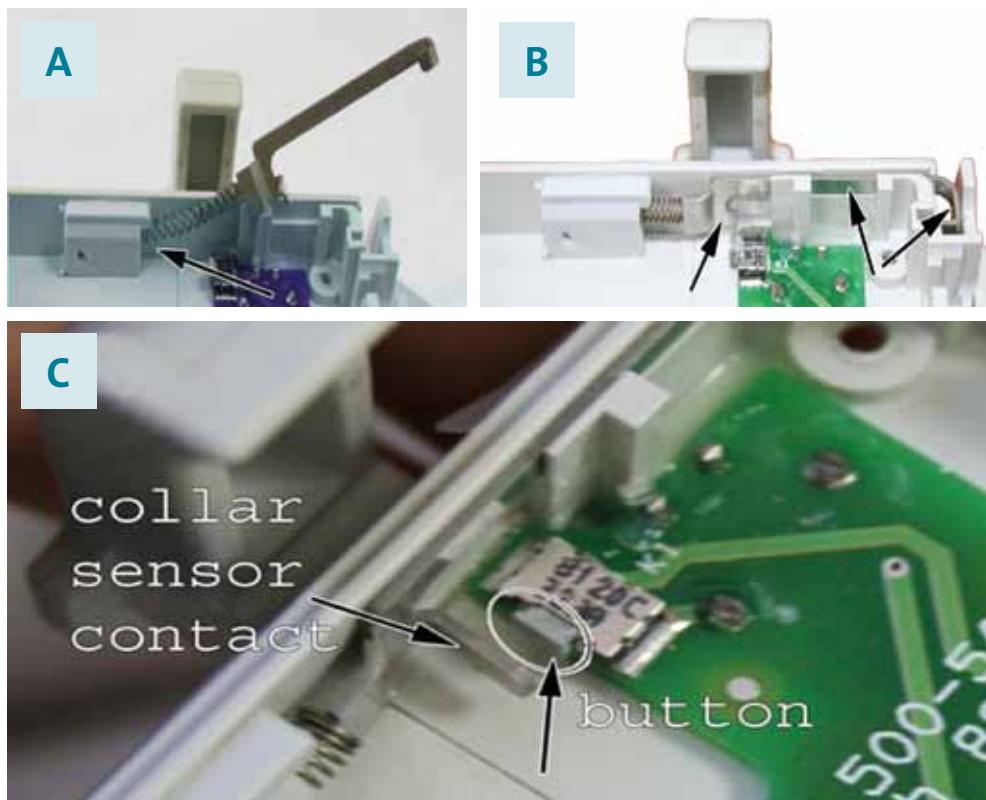


Figure 26. Collar sensor insertion

- g Check with a metric feeler gauge that the distance between the indented contact and the housing is 0.9mm (Figure 27).

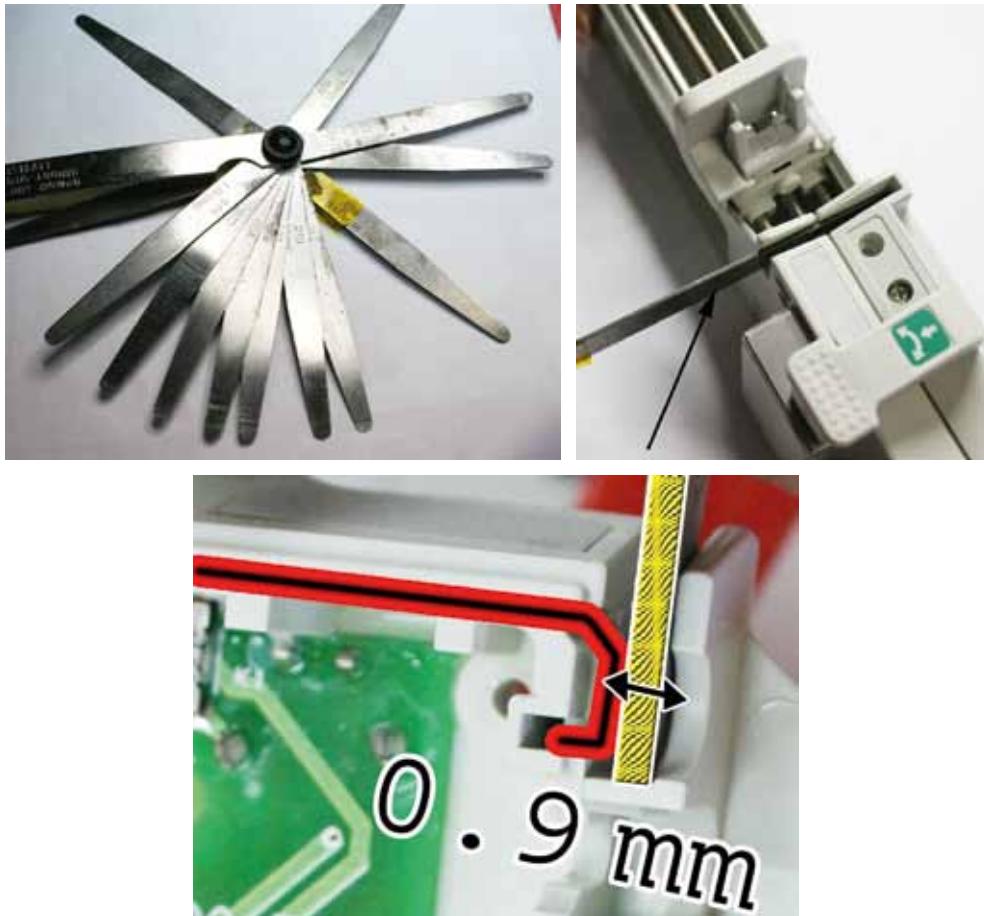


Figure 27. Metric feeler gauge (right), measuring 0.9mm (left and bottom)

- h To correct the distance, if needed, bend the collar sensor contact that touches the button (Figure 28).

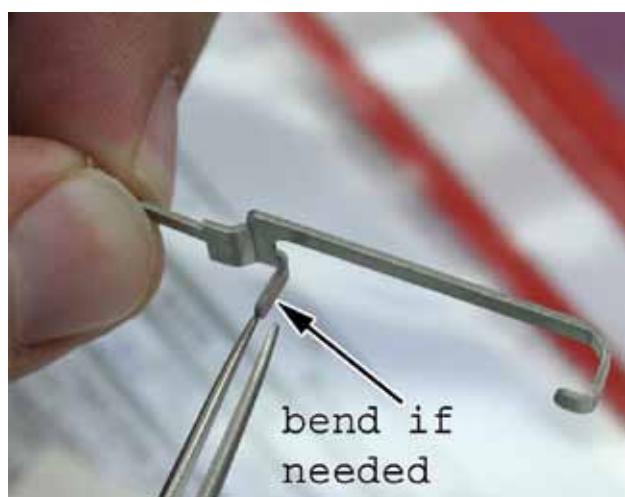


Figure 28. Adjusting the collar sensor contact

- i Perform the operation checklist.



4

Software



Bodycomm communication software

Communication between the T34 syringe pump and a PC is via Bodycomm software, a multipurpose communications software package developed by CME. Bodycomm enables the user – service technician or clinical staff – to set up all T34 and T34L models and to download, save and print the events log.

REQUIRED EQUIPMENT

- PC with a RS232 nine-way serial port or USB-to-RS232 (male) adapter cable (it may be possible also to use an RS232-to-USB connector, but not all of these devices communicate). The RS232-to-USB that we recommend is the Belkin model, which we can supply (part no. F5U103VEA).
- Bodycomm T34 Communications Docking Station (150-312S).
- Bodycomm Connection Cable (197-000X)

NOTE Make sure the battery of the communication station is charged and its contacts are clean.



APPLICATION

Installing and configuring Bodycomm on a PC

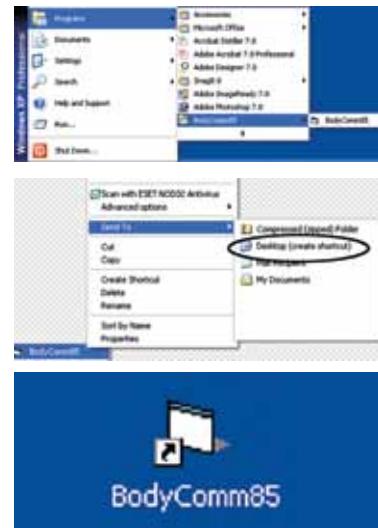
Insert the Bodycomm CD in the computer disk drive. The Set Up program will automatically start; simply follow the instructions. (The Bodycomm software works with Windows operating systems from XP Service Pack 3 onwards. Earlier software is not supported.)

NOTE If you have received the installation file via email, save the Set Up file to your PC and then double-click the Set Up file to start installation.

Desktop shortcut

When installation is complete, create a desktop shortcut for easy starting of Bodycomm:

- 1 Browse to the program location: Start>Programs
 >Bodycomm<X>>Bodycomm<VER>
- 2 Right-click the Bodycomm<VER> program icon to display the shortcut menu and select the 'Send To'>Desktop (create shortcut) option.
The Bodycomm shortcut will be created on your desktop.
- 3 To run Bodycomm, double-click the shortcut on the desktop.



USING RS232 COMMUNICATION FOR T34 MODELS

Connect the RS232 cable to a serial COM port on the PC, and connect the other end to the T34 communication station (Figure 29). If no RS232 port is available on your PC, use a USB-to-RS232 adapter cable (male, with jack screws).



Figure 29. T34 pump communication station with RS232 connection

Switch on the PC.

NOTE Do not plug or unplug cables from the PC while it is switched on.

Do not place yet the pump in the communication station.

To verify complete installation go to the device manager and check under the Ports section. Expand this section using the '+' icon. Check to make sure that the Bodycomm station has installed successfully. If it hasn't, let Windows Update install it by right-clicking the device, selecting Properties, and going to Reinstall Driver. Once the device is installed, it should show a number associated with a COM port; for example: COM1. Make a note of this number.

Double-click the Bodycomm icon. The screen shown in Figure 30 will appear.



Figure 30. Bodycomm Connections Setting screen

The first time the program is run, the COM (communication) port and Baud rate need to be configured. Select the COM port you are using (as noted previously).

Select Baud rate 19200,N,8,2. NOTE: If your pump uses software version NCAT10506, select Baud rate 9600,N,8,1.

The BodyGuard Waiting for Connection screen is displayed on the PC when the Bodycomm software is configured correctly (Figure 31).



Figure 31. Bodycomm initial connection message

USING BODYCOMM FOR SETTING/RETRIEVING DATA

Insert the pump into the communication station by first lifting the syringe holder arm and setting it in the upper position, and then inserting the pump into the communication station. Make sure that the contacts of the station mate properly with the contacts of the pump, as indicated by the 'Insert T34 Here' label (Figure 32).



Figure 32. Inserting pump in communication station

Switch the pump on. If you have selected the correct COM port the Syringe Pump Connected screen (Figure 33) will be displayed.

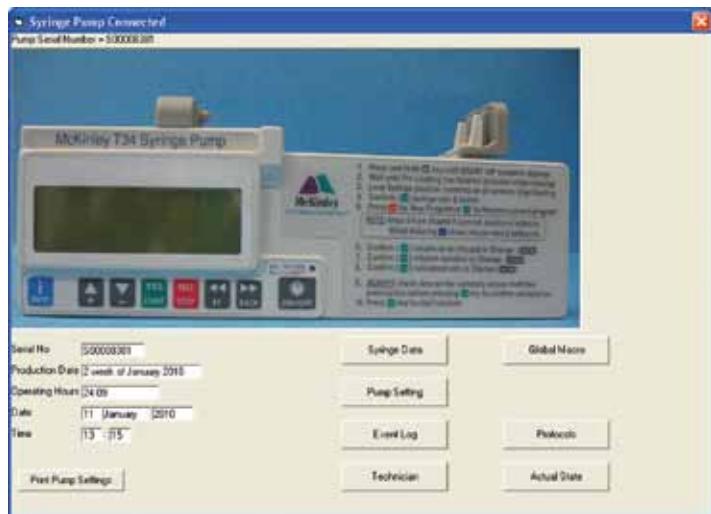


Figure 33. Syringe Pump Connected screen (main screen)

If this screen does not appear, select a different COM port by clicking Configuration on the Waiting for Connection screen and accessing the Bodycomm configuration options as described in the previous procedure. After changing the COM port, switch the pump off and then on again.

The Syringe Pump Connected screen, which is the main screen, displays the pump's serial number, production date, operating hours, date and time, and the T34 syringe Bodycomm options. The picture of a T34 syringe pump indicates that the application has identified the type of pump connected.

Click the required option:

- Print Pump Settings
- Syringe Data
- Pump Setting
- Log
- Technician
- Global Macro
- Actual State

NOTE The Protocols option is not applicable to the T34 syringe pump.

PRINT PUMP SETTINGS

Click this option to print the syringe pump settings (serial number, production date, travel distance, dead space, maximum basal rate, program lock, KVO rate, date settings and more). The information is sent to the PC's default printer.

EXAMPLE PUMP SETTINGS SHEET

Syringe Pump No. S 83921 setting

Serial number	=	S 83921
Production date	=	3 week of January 2007
Barrel clamp down position	=	0
Barrel clamp upper position	=	255
Outside diameter coefficient 1	=	6.6mm
Outside diameter coefficient 2	=	1.03mm/div
Switch 1 position	=	7mm
Switch 2 position	=	60.6mm
Full travel	=	66.8mm
Syringe dead space	=	11mm
Travel force	=	5 (green)
Pressure sensitivity	=	85 (red)
Maximum basal rate	=	5ml/h
Purge vol	=	0.2ml
Pump ID	=	Syringe pump
Software version	=	NCAT10507C
Occlusion pressure	=	10psi
Program lock	=	Enable
KVO rate	=	0ml/h
Titration option	=	Disable
Default operation	=	1440 minutes
Backlight duration	=	5 seconds
Info duration	=	5 seconds
Operation LED	=	32 seconds
FF key operation	=	5mm
Pump clock hours	=	11
Pump clock minutes	=	29
Pump clock date	=	23
Pump clock month	=	March
Pump clock year	=	2011
Operated hours	=	0:28

Date 23/02/2011

Time 10:32:30

SYRINGE DATA

From the main screen, click Syringe Data to view the Set Up of the supported syringes (Figure 34).

If you need to make changes in the syringe set up, such as the dimensions and whether they are enabled or disabled, click Change Set Up. When prompted for the code, enter the pump Change Set Up access code (the default is 123) and press OK.

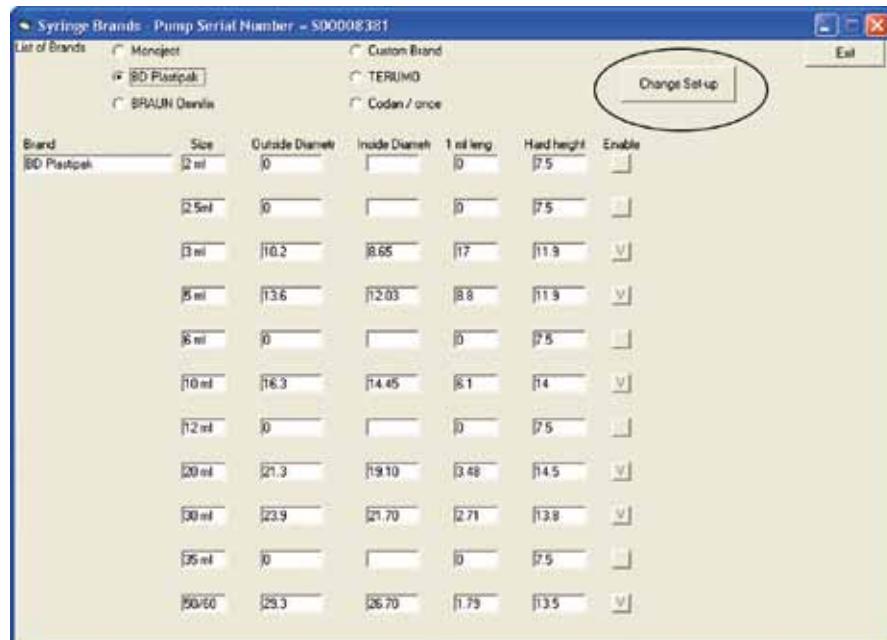


Figure 34. Syringe Data – Syringe Brands screen

NOTE After modifying each value, press Enter on your keyboard to apply the change.
If you continue without pressing Enter, the new value will not be saved.

Click Exit to return to the main screen.

PUMP SETTING

From the main screen, click Pump Setting to display settings stored in the pump (Figure 35).

If needed, click Change Set Up to make changes in the values.

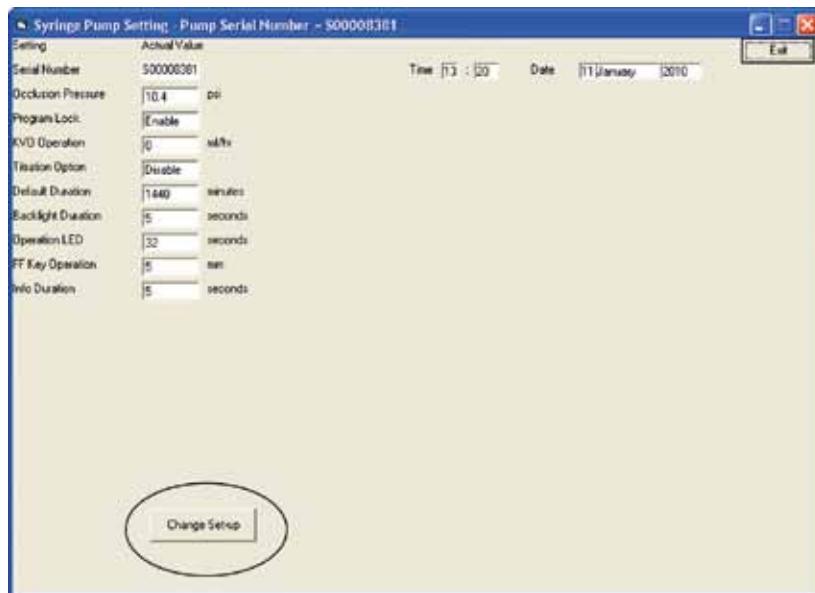


Figure 35. Pump Setting screen

When prompted for the code, enter the Change Set Up access code (the default is 99) and press OK.

NOTE: After modifying each value, click OK or press Enter on your keyboard to apply the change. Otherwise the previous value will remain. All settings apart from the pump serial number can be modified.

If needed, click Update Time from Computer Clock to set the pump's time and date to the PC's time and date.

Click Exit to return to the main screen.

EVENT LOG

The pump stores the last 512 events in its memory. Bodycomm can access this event history and display the entries. An event log can be saved for inspection if needed.

From the main screen click Event Log. This initiates the events download from the pump to the PC. The Events screen for the pump is displayed (Figure 36).

Event no.	Date	Time	State	Posit mm	VTBI ml	VI ml	Rate ml/h	Time	Syringe	Leng mm/ml	Akt maxNg	Alarm maxNg	Datt	Total VI ml	Prot Prot
36	08Feb2000	22:00	Pump Operating	2.13	0.13	5.05	0.22	0:36	5 ml BD	6.70	136	540	9.0V	0	
37	08Feb2000	22:35	End of Infusion	1.00	0.00	5.18	---	--:--	5 ml BD	6.70	0	540	9.0V	0	
38	08Feb2000	22:36	Switched OFF	1.02	0.00	5.17	---	--:--	5 ml BD	6.70	0	540	8.8V	0	
39	12Feb2000	19:51	Switched ON	1.05	---	---	---	--:--	---	0.00	--	540	7.8V	0	
40	12Feb2000	19:51	Volume Change	1.05	---	---	---	--:--	---	0.00	--	540	7.8V	0	
41	11Jan2010	12:51	Switched ON	46.18	---	---	---	--:--	---	0.00	--	540	0.1V	0	
42	11Jan2010	12:51	Volume Change	46.18	---	---	---	--:--	---	0.00	--	540	0.1V	0	
43	11Jan2010	12:51	Switched OFF	46.08	---	---	---	--:--	---	0.00	--	540	0.1V	0	
44	11Jan2010	12:52	Switched ON	69.10	---	---	---	--:--	---	0.00	--	540	0.1V	0	
45	11Jan2010	12:53	Switched OFF	69.10	---	---	---	--:--	---	0.00	--	540	0.1V	0	
46	11Jan2010	12:53	Switched ON	69.12	---	---	---	--:--	---	0.00	--	540	0.0V	0	
47	11Jan2010	12:54	Switched OFF	69.12	---	---	---	--:--	---	0.00	--	540	0.1V	0	
48	11Jan2010	12:54	Switched ON	69.13	---	---	---	--:--	---	0.00	--	540	0.0V	0	
49	11Jan2010	12:56	Switched OFF	69.13	---	---	---	--:--	---	0.00	--	540	0.1V	0	
50	11Jan2010	12:56	Switched ON	69.13	---	---	---	--:--	---	0.00	--	540	0.0V	0	
51	11Jan2010	12:57	Switched OFF	69.15	---	---	---	--:--	---	0.00	--	540	0.1V	0	
52	11Jan2010	12:58	Switched ON	69.17	---	---	---	--:--	---	0.00	--	540	0.0V	0	
53	11Jan2010	12:58	Switched OFF	69.17	---	---	---	--:--	---	0.00	--	540	0.1V	0	
54	11Jan2010	12:58	Switched ON	69.17	---	---	---	--:--	---	0.00	--	540	0.0V	0	
55	11Jan2010	13:00	Switched OFF	69.17	---	---	---	--:--	---	0.00	--	540	0.0V	0	
56	11Jan2010	13:00	Switched ON	69.18	---	---	---	--:--	---	0.00	--	540	0.0V	0	
57	11Jan2010	13:00	Switched OFF	69.18	---	---	---	--:--	---	0.00	--	540	0.0V	0	
58	11Jan2010	13:01	Switched ON	69.20	---	---	---	--:--	---	0.00	--	540	0.0V	0	
59	11Jan2010	13:01	Switched OFF	69.20	---	---	---	--:--	---	0.00	--	540	0.0V	0	
60	11Jan2010	13:02	Switched ON	69.20	---	---	---	--:--	---	0.00	--	540	0.0V	0	
61	11Jan2010	13:03	Switched OFF	69.20	---	---	---	--:--	---	0.00	--	540	0.0V	0	
62	11Jan2010	13:04	Switched ON	69.23	---	---	---	--:--	---	0.00	--	540	0.0V	0	
63	11Jan2010	13:05	Switched OFF	69.23	---	---	---	--:--	---	0.00	--	540	0.0V	0	
64	11Jan2010	13:11	Switched ON	69.23	---	---	---	--:--	---	0.00	--	540	0.1V	0	
65	11Jan2010	13:11	Switched OFF	69.23	---	---	---	--:--	---	0.00	--	540	0.1V	0	
66	11Jan2010	13:19	Switched ON	69.27	---	---	---	--:--	---	0.00	--	540	0.1V	0	

Figure 36. Events screen

Enter in the Patient Name, Age, and Notes boxes the relevant information. This ensures that if there is an incident all the relevant details are stored with the event log.

Enter a filename for the event log in the Create File box. Press OK to save the event log file. By default the event log file is saved as a .txt file in the Bodycomm folder. To save the file in a different location, specify the path in the 'Create File' box; for example, C:\Documents and Settings\Service\Logs\MercyHospital\Events_JohnDoe.txt

The saved event log file can be printed out and used for troubleshooting pump issues. It is also useful for filling in patient records.

TECHNICIAN

From the main screen click Technician to display the pump calibrations and settings as recorded in Technician Mode.

If needed, click Change Set Up to make changes in the Maximum Rate and Purge Volume values. (Serial number and production date values cannot be modified.)

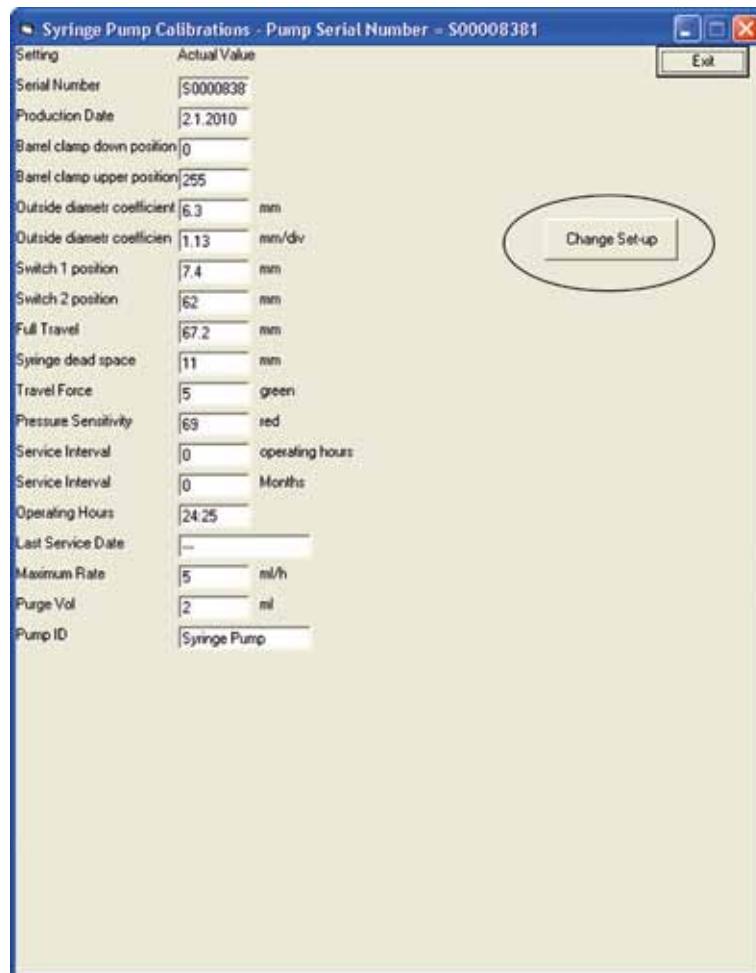


Figure 37. Technician Calibrations screen

When prompted for the code, enter the Technician access code (the default is 123) and press OK.

Click Exit to return to the main screen.

NOTE After modifying each value, click OK or press Enter on your keyboard to apply the change. Otherwise the previous value will remain. All settings apart from the pump serial number can be modified.

We recommend that you do not change the calibration settings.

GLOBAL MACRO

If there are a number of pumps that need to be programmed to the same specific settings, to save time you can use a macro to automatically change the settings.

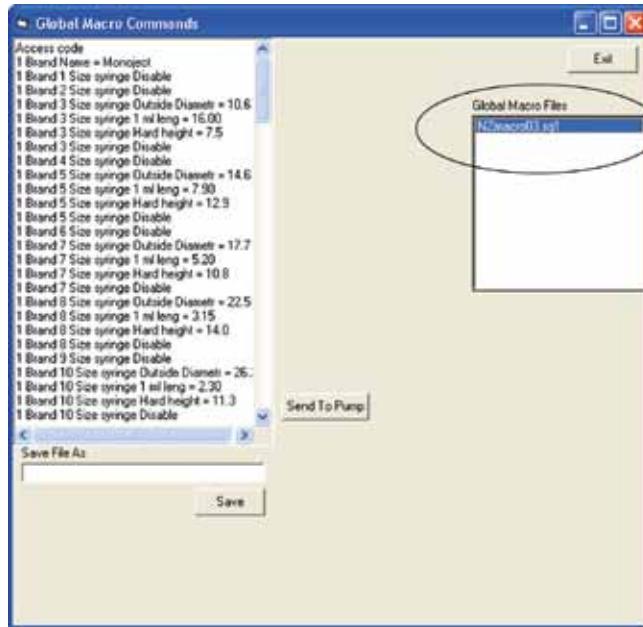


Figure 38. Global Macro Commands screen

Global macros are customised .sgi files. They can be ordered from the T34 syringe pump supplier, or alternatively you can create them after you have manually made all of your required changes when setting up a syringe pump. Once installed in the Bodycomm program folder, the macros are listed in the Global Macro Files area of the screen.

Running Global Macros

To run a macro, from the main screen click Global Macro.

Select the required file from the Global Macro Files list (right panel in Figure 38). The selected macro phrases will be displayed in the macro window (left panel).

NOTE Running a global macro file is irreversible. The settings applied by the macro cannot be cancelled.

Click Send to Pump. The pump settings will change to the values recorded in the selected macro.

Creating a global macro

All of the changes that you make manually to the pump settings are recorded in the left panel on the Global Macro screen (Figure 39). To group the changes in a global macro file that you can run on additional pumps, do the following:

- Make the required changes to the pump settings using Bodycomm's Syringe Data, Pump Setting, and Technician options.
- From the main screen click Global Macro.
- Check that the macro phrases in the left panel (Figure 39, a) are as you require.

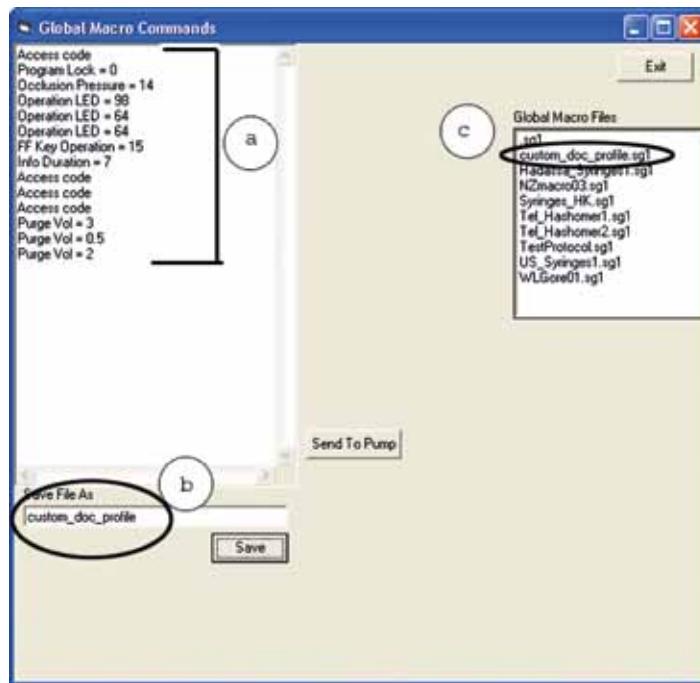


Figure 39. Global Macro screen, new macro

- Enter a name for the new macro in the Save File As box (Figure 39, b).
- Click Save. The new macro is saved with the name you provided and is added to the Global Macro Files list (Figure 39, c).
- For the next T34 syringe pump to which you need to apply these settings, select this macro from the list and click Send To Pump.

NOTE Running a global macro file is irreversible. The settings applied by the macro cannot be cancelled.

ACTUAL STATE

To obtain a snapshot of the connected pump's status, click the Actual State option on the main screen.

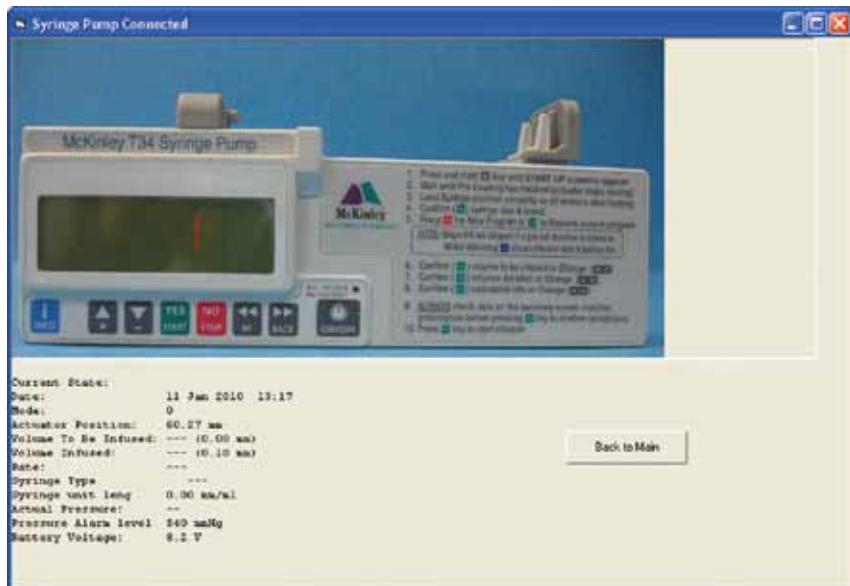


Figure 40. Actual State – Pump Connected screen

List of events and alarms

The event log messages are of two types: operation events and alarms.

ALARMS	
1 Timer communication fail	16 Revolution enc. Fail
2 External EEPROM fail	17 No motor steps – 20 min
3 Timer battery fail	18 Motor voltage overflow
4 Internal EEPROM fail	19 Long revolution time
4 Hardware reset	20 Short revolution time
5 Setting test fail	21 Over revolution in minutes
6 Start Up motor stop fail	22 Less revolution in minutes
7 Watchdog current	23 No rotation detected
8 Watchdog time error	24 Actual Rate test error
9 CPU test error	22 Startup motor move fail
10 Shadow compare error	23 Ends sensor fail
11 ADC converter fail	24 Current sensor fail
12 Oscillators fail	25 Syringe type diameter
13 STAC overflow	26 Wrong volume length
14 UDP counter overflow	27 Long stop mode interval
15 External light fail	29 Reset by COP counter

OPERATION EVENTS	
1 Event Number	10 Pressure Actual
2 Date and Time	11 Battery Voltage
3 Switch On	12 Rate Titration
4 Info: Volume Infused	13 Stop
5 Volume To Be Infused	14 Low Battery
6 Rate	15 Pump Unattended
7 Type of Syringe	16 Down Occlusion
8 Length (ml/mm)	17 End Travel
9 Pressure Settings (0–10psi)	18 Syringe Displaced

Table 3. Event log messages

5

Troubleshooting & manufacturer notices

Troubleshooting

NOTE In the event that corrective action does not solve a problem, return the unit to CME.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Different volume infused (VI) than the predetermined volume to be infused (VTB)	Wrong detection of syringe, or incorrect setting of syringe data	Check that the correct syringe is selected
		Perform Syringe Travel Calibration (Technician menu)
		Check Hard Height measurement in Technician menu
		Perform preloading
Actual pressure differs from pressure detected	Calibration due	Recalibrate pressure accuracy
Pump does not switch on	Battery contacts on the rear PCB unsoldered	Re-solder battery contacts
	Battery depleted	Change battery
	Battery missing	Insert a battery
Power Up alarm	Encoder plate not mounted properly	Remount the encoder plate
	Encoder LEDs or phototransistors are damaged	Replace encoder PCB
	Motor does not rotate	Replace motor
	On/Off key malfunction	Replace the main PCB
Pump does not perform preloading	Syringe holder is in the upper position	Set syringe holder to the down position
	Syringe present in the pump	Remove syringe
The FF and Back keys do not function	A syringe is loaded	Remove syringe
	Syringe holder is in the upper position	Set syringe holder to the down position
	Syringe sensor malfunction	Replace syringe sensor. Check connection on the front pumping block. If it has no fault, replace slide potentiometer
Purge disabled	Pump was switched on while a syringe was loaded	Remove syringe and switch the pump off and then on again
Volume cannot be increased	Pump will not permit an increase in volume above the volume in the syringe	This is the intended functionality – no need to resolve
Syringe holder sensor not sliding	Syringe detection sensor malfunction	Replace syringe holder

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Operation LED does not flash	Operation LED is not working during operation	Check Set Up to ensure LED is enabled. If this is not the cause, change the main PCB
Maximal basal rate limited	Maximal rate setting is set to a low value	Change the maximal rate to a higher limit in Change Set Up
User can't titrate rate during operation	In Change Set Up the rate titration setting is disabled	Enable titration in Change Set Up
	Program is in Lock state	Unlock program
Down Occlusion	Occlusion detection malfunction	Recalibrate pressure. If this doesn't resolve the issue, replace main PCB; if this doesn't resolve change entire pumping mechanism
Hardware reset or reset by external pin	External noise	Turn the pump off and on again. If the problem persists, replace main PCB
	9V battery low or depleted	Replace battery
	Battery contacts are dirty	Clean battery contacts
	Mechanical malfunction	Check motor and replace
	Motor PCB malfunction	Replace motor PCB
Setting Test fail	Main PCB malfunction	Replace main PCB
	RAM corruption	Turn the pump off and then on again using the same syringe. If problem persists, send to service
	Syringe data out of range	Enter technician mode and check the data for the current syringe
	Data setting corrupted	Restore data by performing Factory Setting
	Device not calibrated after main PCB replacement	Perform calibration of Syringe Travel, Syringe Diameter and Pressure Calibration
Long Stop Mode interval or reset by COP counter	Corruption of S/N, production date and dead space	Enter those parameters and confirm
	Timer communication fail	Turn the pump off and then on again. If problem persists replace lithium battery
		Check and replace motor PCB
Start Up motor fail	Failure during switch on test	Restart the pump. If problem persists perform the following:
	Motor PCB malfunction	Replace motor PCB
	Malfunction of main PCB	Replace main PCB

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Actual Rate test fails or Long Revolution Time error	Mechanical malfunction or high friction of syringe	Check the pump is calibrated to operate with new syringe, or replace pumping assembly
	End of travel, forcing syringe against housing	
	Refer to Revolution Encoder fail, below	
Revolution encoder fail	External noise	Turn the pump off and then on again. If problem persists, perform the following:
	Magnet on motor adaptor weak or disconnected	Replace contact screw (black) on the bottom of front pumping block to m3 x 5 mm
	Reed switch 1, 2 broken	Replace motor PCB
Watchdog current	Encoder plate loose	Tighten encoder plate
	Motor PCB malfunction	Replace motor PCB
	Main PCB malfunction	Replace main PCB
Watchdog time error	Main PCB malfunction	Replace main PCB
Shadow compare error	RAM corruption	Turn the pump off and then on again. If problem persists, replace main PCB
Oscillator fail	Lithium battery discharged	Turn the pump off and then on again. If problem persists, check / replace lithium battery
	Water ingress	Dry the device
	Clogged or dirty PCB pins connector	Clean pins of connector between main and motor PCBs
	Motor PCB malfunction	Replace motor PCB
	Main PCB malfunction	Replace main PCB
Stack overflow	Microprocessor malfunction	Replace main PCB
UPD counter overflow or motor current overflow	Mechanical malfunction; motor PCB or connection to main PCB faulty; encoder PCB malfunction; or encoder plate loose	1 Perform Syringe Travel calibration 2 Replace pumping block 3 Replace motor PCB and clean connectors 4 Replace encoder PCB 5 Fasten encoder plate
UPD counter overflow or Motor current overflow	Mechanical malfunction	Perform Syringe Travel calibration Access Manual Test; perform Motor Test
		Replace pumping block
		Replace motor PCB and clean connectors
	Encoder PCB malfunction	Replace encoder PCB
	Encoder plate loose	Fasten encoder plate
ADC converter fail	External interrupt or electronic malfunction (electrostatic discharge)	Turn the pump off and then on again. If problem persists, replace main PCB

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
External light fail	Encoder detects external light	Make sure pump case is not broken and that it is closed with six screws
	External noise	Turn the pump off and then on again. If problem persists, send to service
	Malfunction of encoder PCB	Replace encoder PCB
	Connecting cable between encoder and main PCB damaged	Check or replace the connecting cable
	Main PCB malfunction	Replace main PCB
Internal EEPROM fail	Microprocessor malfunction	Replace main PCB
	Memory malfunction	Turn the pump off and on again. If problem persists take the following steps, testing at each step: 1 Perform Factory Setting from Technician Mode 2 Recalibrate the pump from Reset Calibration 3 Replace main PCB
No motor steps for 20 minutes	Main PCB malfunction	Replace main PCB
No rotation detected	Encoder malfunction	Turn the pump off and on again
	Motor malfunction	Replace block assembly
		Replace main PCB
		If problem persists, send to service
Start Up motor move fail	Lock at end travel	From Technician Mode, run Syringe Travel Test. Alternatively, move manually out of locking
	Mechanical or motor malfunction	Turn the pump off and then on again. If problem persists, replace pump mechanics
	Motor PCB malfunction	Replace motor PCB and check pins of connector to main PCB
	Malfunction of main PCB	Replace main PCB
	Encoder plates loose	Tighten encoder plates
	Encoder or connecting flat cable malfunction	Check and replace encoder PCB and flat cable to main PCB
Ends Sensor fail	Limit sensor malfunction	Check or replace reed switches (K1)
	Magnet on actuator weak	Replace actuator magnet
	Flat cable malfunction	Check or replace flat cable connecting main and encoder PCBs

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Current sensor fail	Motor PCB malfunction	Replace motor PCB
	Main PCB malfunction	Replace main PCB
Wrong syringe detection	Syringe diameter not calibrated	Enter Technician Mode and perform Syringe Diameter test. Recalibrate if necessary
Wrong volume lengths	Wrong data entered	Recalibrate syringe, check syringe data, and update if necessary
CPU test error	Microprocessor malfunction	Replace main PCB
Timer communication fail	External noise during communication	Turn the pump off and then on again and set pump to operate on 0.1ml/h. If problem persists perform the following:
	Timer battery low	Check voltage on lithium battery; if less than 3v, replace battery
	Motor PCB malfunction	Replace motor PCB
	Main PCB malfunction	Replace main PCB
Timer battery fail	It is the first pump operation after service	Turn the pump off and then on again
	Lithium 3V battery damaged	Replace 3V lithium battery
External EEPROM fail	External noise during communication	Turn the pump off and on again and set pump to operate on 0.1ml/h. If problem persists perform the following:
	Motor PCB malfunction	Replace motor PCB
	Main PCB malfunction	Replace main PCB

NOTE To avoid the possibility of the pump not discerning between syringes, we recommend using only approved brands. Avoid using brands with external diameters with a difference of less than 0.5mm. Your medical staff should specify the syringe types that best fit their needs.

Frequently asked questions

T34 HARD HEIGHT

Hard height is the distance, measured in millimetres, between the front edge of a syringe collar and the back edge of the syringe plunger when the syringe is empty and the plunger is pushed right in (Figure 1). This value differs between syringe brands and sizes and is usually bigger on larger-volume syringes. The Pump Technician field contains the hard height data for all syringes.

Dead space is a fixed distance on the T34 pump between the front edge of the slot where the syringe collar sits (middle sensor) and the front edge of the actuator (Figure 1, shown in blue) when the actuator is at the end-of-travel position; that is, where the back edge of the plunger sits. At this point the actuator cannot drive any further forward.

Undeliverable volume. In Figure 1 the hard height of the syringe is the same as the dead space on the pump. This means that when the actuator reaches the end of travel, it will have pushed the plunger on the syringe fully in, therefore having delivered the entire contents of the syringe.

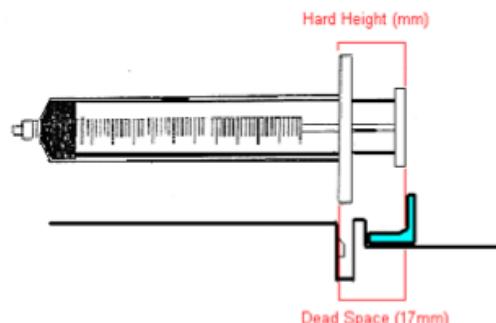


Figure 1. Syringe hard height same as pump dead space, resulting in no undeliverable volume

What happens if hard height of the syringe is greater than the dead space?

Some syringes have a hard height greater than the dead space. In such a case the actuator cannot reach the end-of-travel position because the syringe is empty before it gets there. Since the pump calculates what is in the syringe it should alarm End of Infusion at this position.

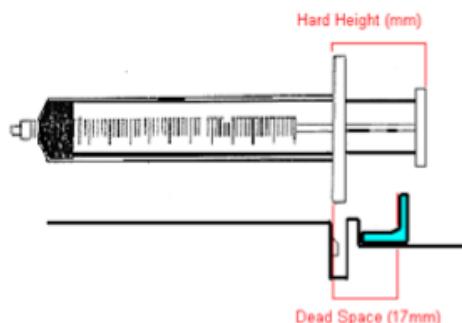


Figure 2. Syringe hard height greater than dead space, resulting in no undeliverable volume

What happens if hard height of the syringe is less than the dead space?

Some syringes have a hard height less than the dead space. In such a case, when the actuator has reached the end-of-travel position the syringe will still contain some fluid. For example, if the hard height is 17mm and the dead space 15mm, the plunger will still be 2mm from emptying (Figure 3).

As the pump database contains the hard height and dead space information it can calculate the undeliverable volume before the start of infusion and alert the user. This is displayed on the screen during set up as 'Volume 2.04 (of 2.4)ml', for example, indicating that of the 2.4ml in the syringe only 2.04ml is deliverable due to the pump structure.

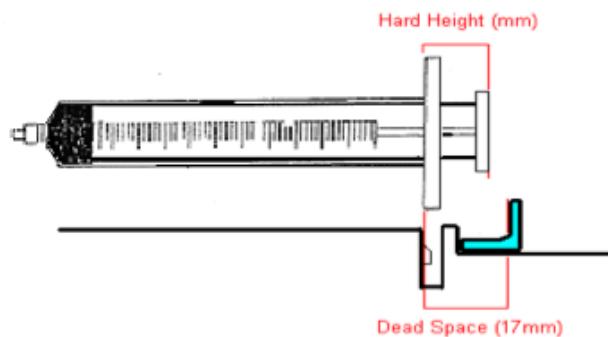


Figure 3. Syringe hard height less than dead space, resulting in some undeliverable volume



Figure 4. Set up showing undeliverable volume (yellow) when actuator is at end-of-travel position



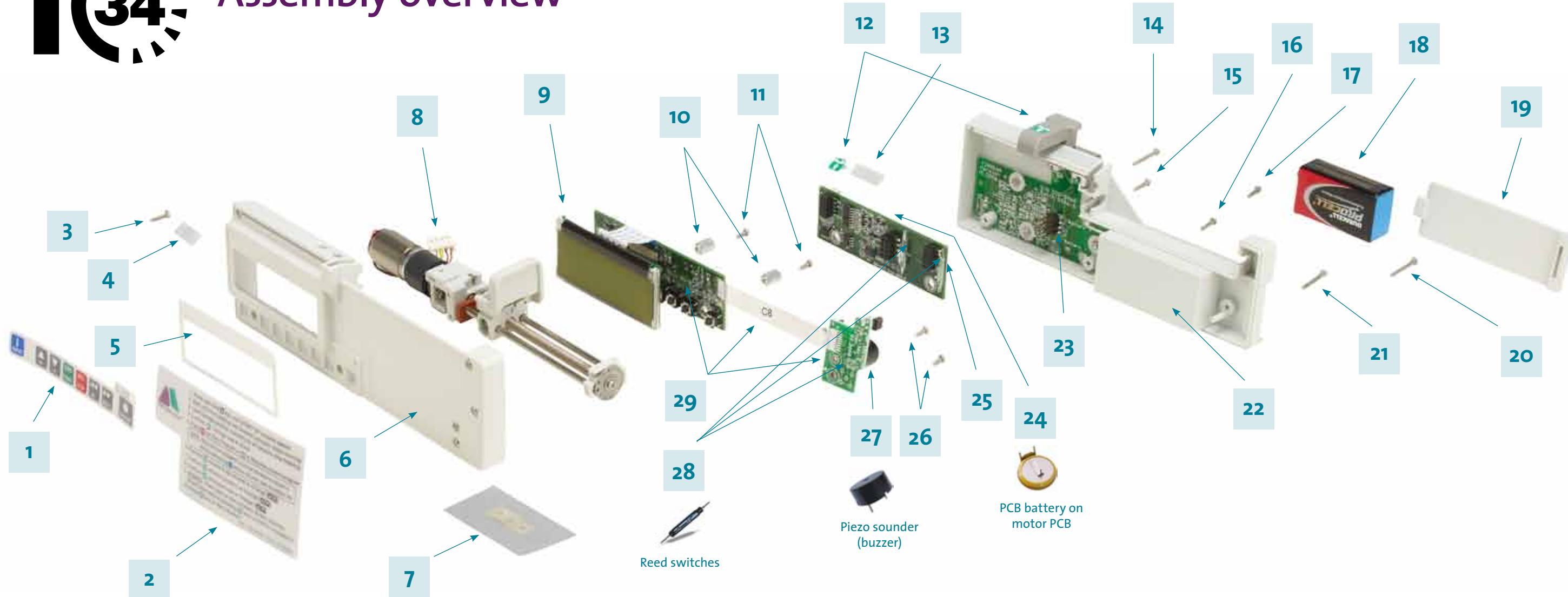
6

Appendices





Assembly overview

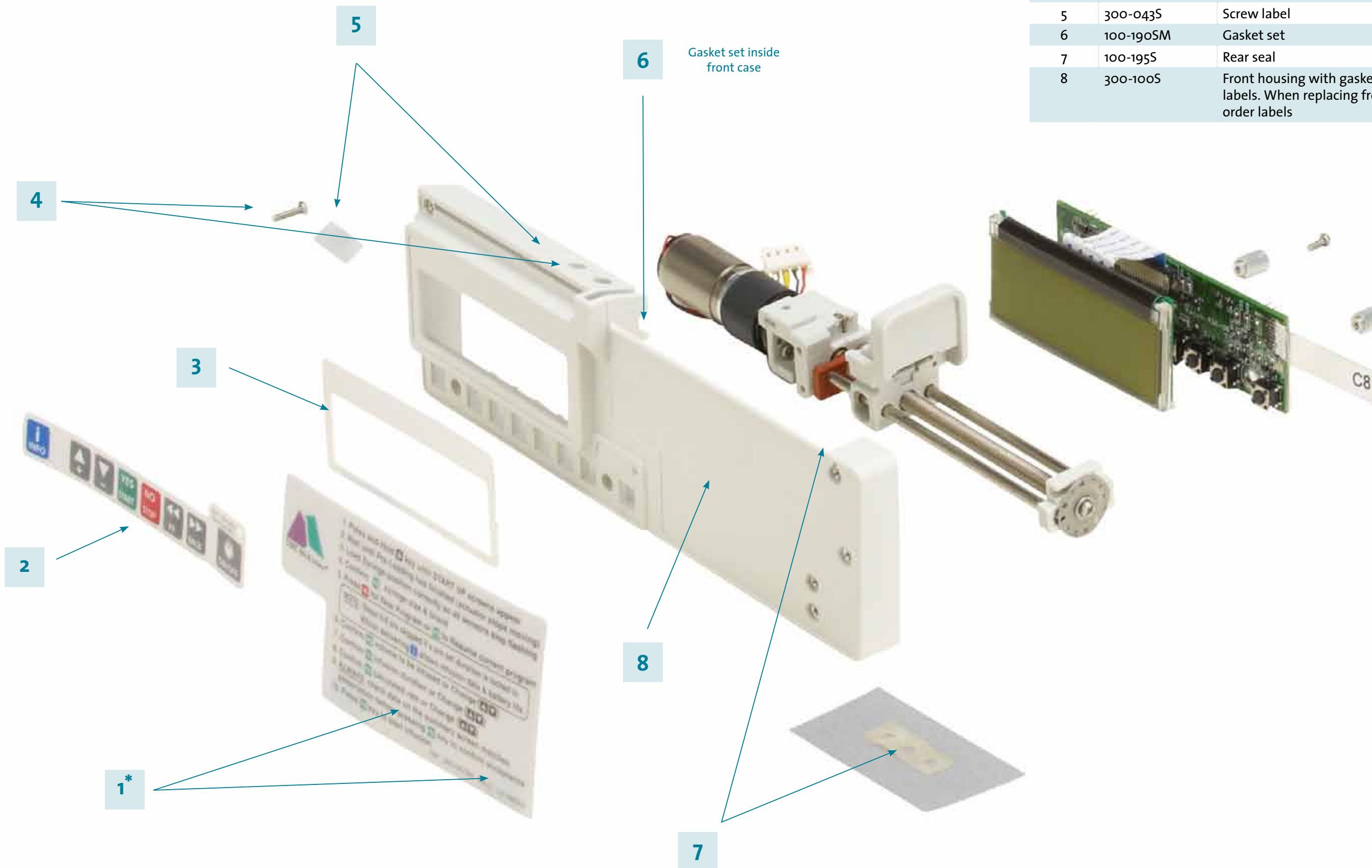


The parts listed above and in the next colour drawings are the only parts available from CME Medical

Location	Part number	Description
1	300-040S	Keypad label
2	300-042SM	Instruction label
3	200-012	Screw M2x8, T34 motor block
4	300-043S	Screw label
5	300-041S	Display label
6	300-100S	Front housing with gasket set (no labels)
7	100-195S	Rear seal
8	200-000S	T34 block assembly
9a	500-300S-BF	New LCD for main PCB, version 6 (2010 onward)
9b	500-300S	Old LCD for main PCB, pre-version 6 (pre-2010)
10	300-002S	PCB spacer
11	200-070	Screw M2x5
12	300-045S	Syringe holder label (green)
13	300-043S	Screw label
14	300-570X	Screw M2x20, T34 case, long (upper right)

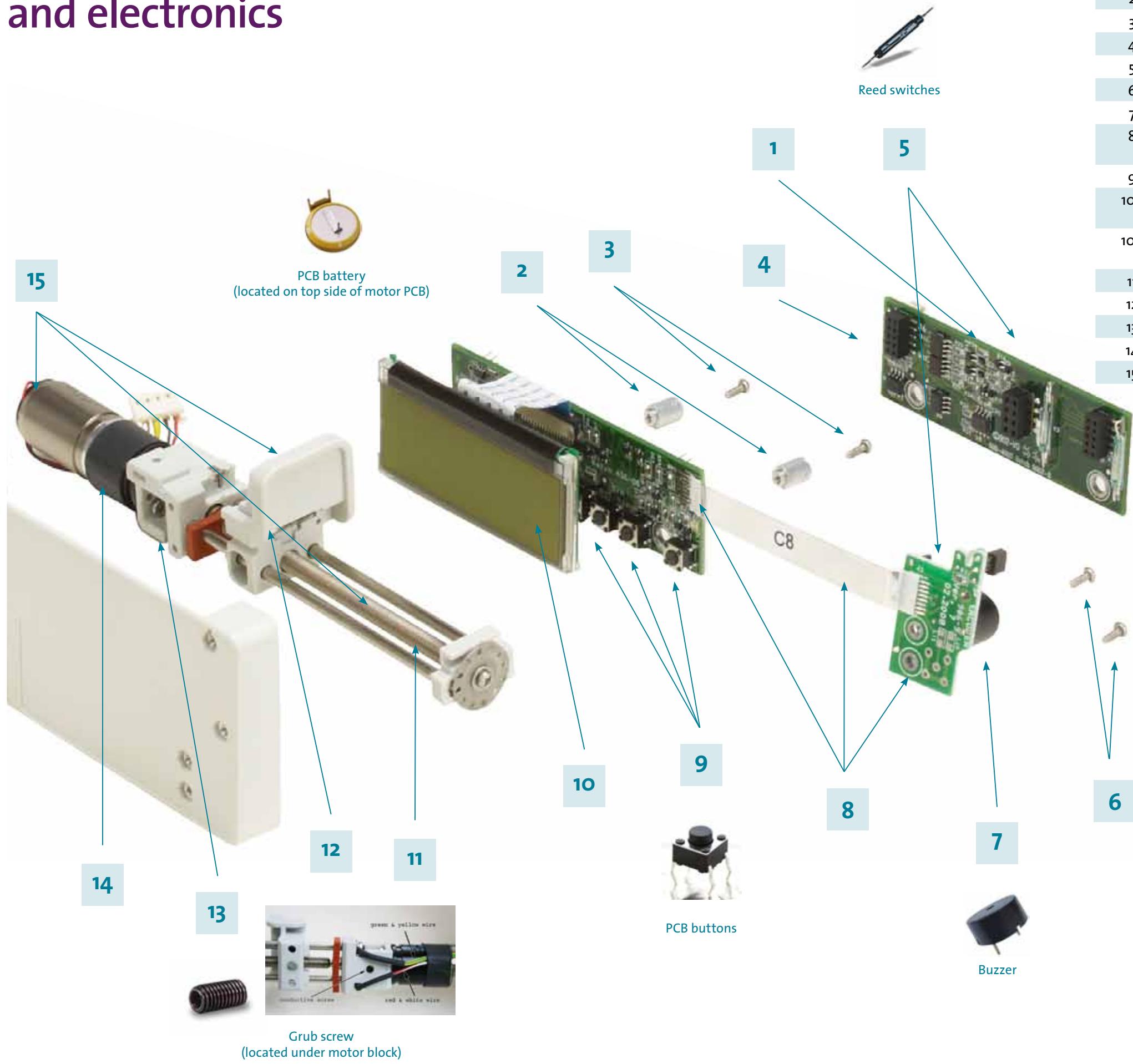
Location	Part number	Description
15	300-580X	Screw M2x10, T34 case (lower right)
16	300-580X	Screw M2x10, T34 case (lower centre)
17	200-012	Screw M2x8, motor block (upper centre)
18	Not sold	9V Procell Duracell battery
19	M400-002S	Battery cover
20	600-003T	Screw M2x18, T34 case, battery cover (lower left)
21	300-570X	Screw M2x20, T34 case, long (upper left)
22	400-000S	Rear case assembly
23	500-546S	Rear case PCB
24	500-300X	PCB battery
25	500-402S	Motor PCB
26	200-070	Screw M2x5
27	400-600X	Piezo sounder (buzzer)
28	500-711XC	Reed switch
29	500-727S	Main PCB, including encoder PCB (and connecting cable) When ordering a new PCB please provide the software version of your older PCB, so that the correct software is programmed onto the new unit

Front assembly



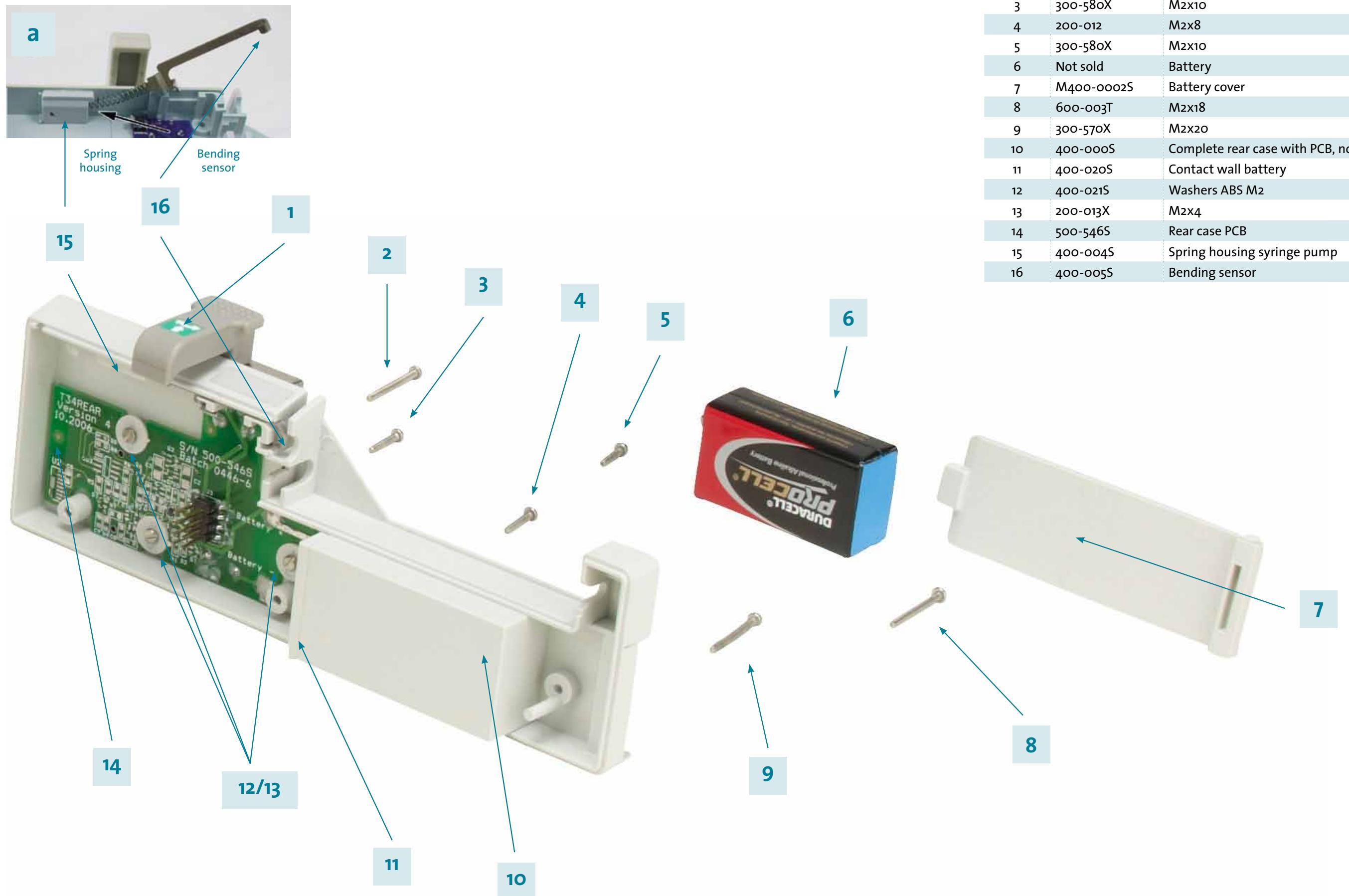
Location	Part number	Description
1*	300-042SM	Instruction label * REV 2 for software versions below NCAT1o6o8C / above NCAT1o6o8C Use REV 3
2	300-040S	Keypad label
3	300-041S	Display label
4	200-012	Screw M2x8, T34 motor block
5	300-043S	Screw label
6	100-190SM	Gasket set
7	100-195S	Rear seal
8	300-100S	Front housing with gasket set and no labels. When replacing front case please order labels

Motor block assembly and electronics



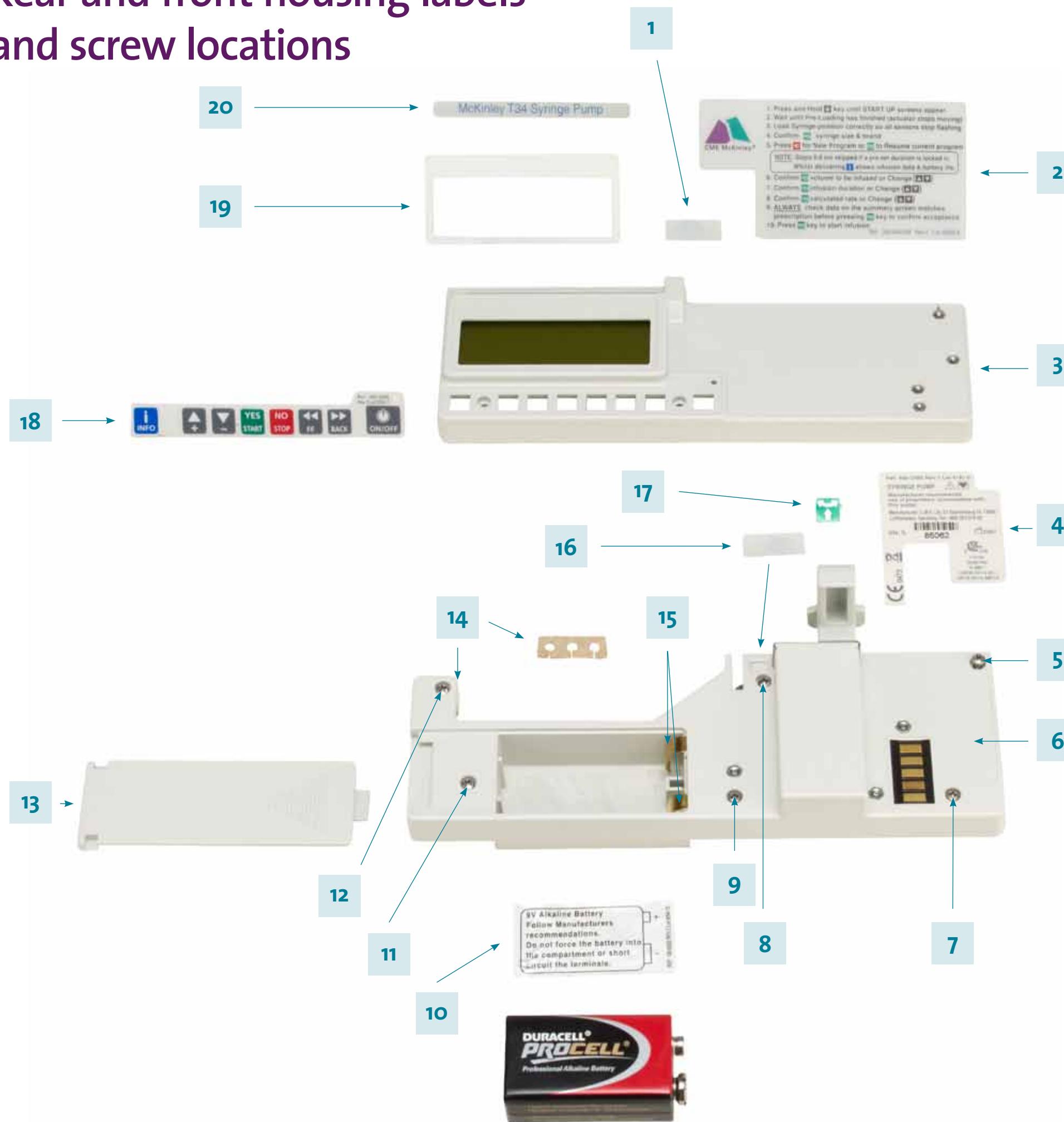
Location	Part number	Description
1	500-300X	PCB battery
2	300-002S	PCB spacer
3	200-070	Screw M2x5
4	500-402S	Motor PCB
5	500-711XC	Reed switch
6	200-070	Screw M2x5
7	400-600X	Piezo sounder (buzzer)
8	500-727S	Main PCB, including encoder PCB and connecting cable
9	500-306S	Keypad button
10a	500-300S	New LCD for main PCB version 6 (2010 onwards)
10b	500-300S-BF	Old LCD for main PCB prior to version 6 (pre-2010)
11	200-050S	Lead screw
12	230-000S	Actuator assembly
13	200-028S	Hex grub screw
14	220-000S	Motor
15	200-000S	Complete block assembly

Rear case and electronics



Location	Part number	Description
1	300-045S	Syringe holder label (green)
2	300-570X	M2x20
3	300-580X	M2x10
4	200-012	M2x8
5	300-580X	M2x10
6	Not sold	Battery
7	M400-0002S	Battery cover
8	600-003T	M2x18
9	300-570X	M2x20
10	400-000S	Complete rear case with PCB, no labels
11	400-020S	Contact wall battery
12	400-021S	Washers ABS M2
13	200-013X	M2x4
14	500-546S	Rear case PCB
15	400-004S	Spring housing syringe pump
16	400-005S	Bending sensor

Rear and front housing labels and screw locations

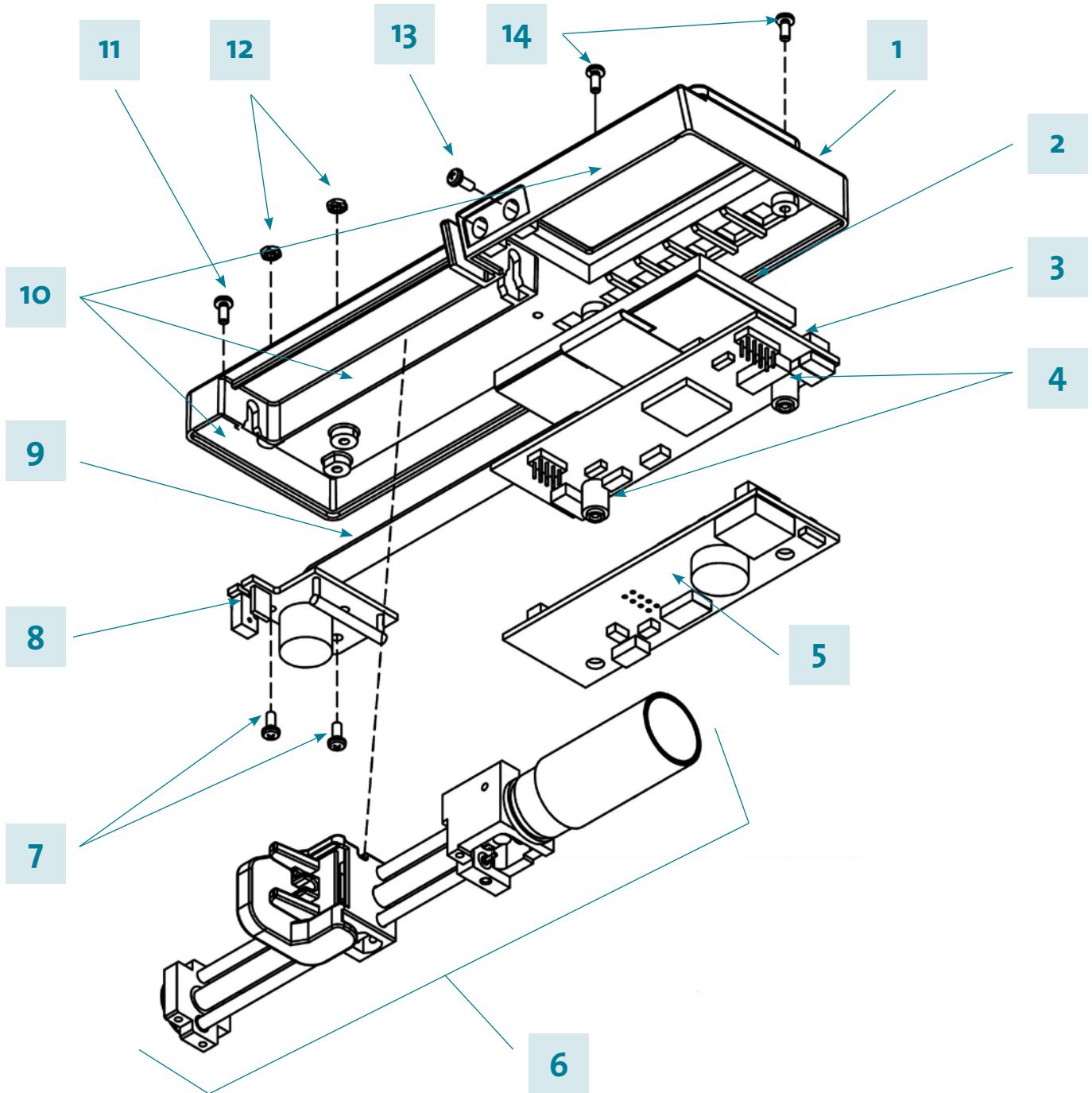


Location	Part number	Description
1	300-043S	Screw label
2	300-042SM	Instruction label
3†	300-100S	Front housing with gasket set
4	400-339SSP	Serial number
5	300-570X	Upper R screw, M2x20
6*	400-000S	Rear case without labels, with rear PCB
7	300-580X	Lower R screw, M2x10
8	200-012	Upper centre screw, M2x8
9	300-580X	Lower centre screw, M2x10
10	130-005S	Battery label
11	600-003T	Lower L screw, M2x18
12	300-570X	Upper L screw, M2x20
13	M400-002S	Battery cover
14	100-195S	Rear seal
15	400-604S	Battery contacts
16	300-043S	Screw label
17	300-045S	Syringe holder label (green)
18	300-040S	Keypad label
19	300-041S	Display label
20	250-014SM	T34 syringe label

† NOTE When ordering a front case (item #3 in the list above), you will also need to order the following parts:
 300-043S Screw label (#1)
 300-042SM Instruction label (#2)
 300-040S Keypad label (#18)
 300-041S Display label (#19)
 250-014SM T34 syringe label (#20)

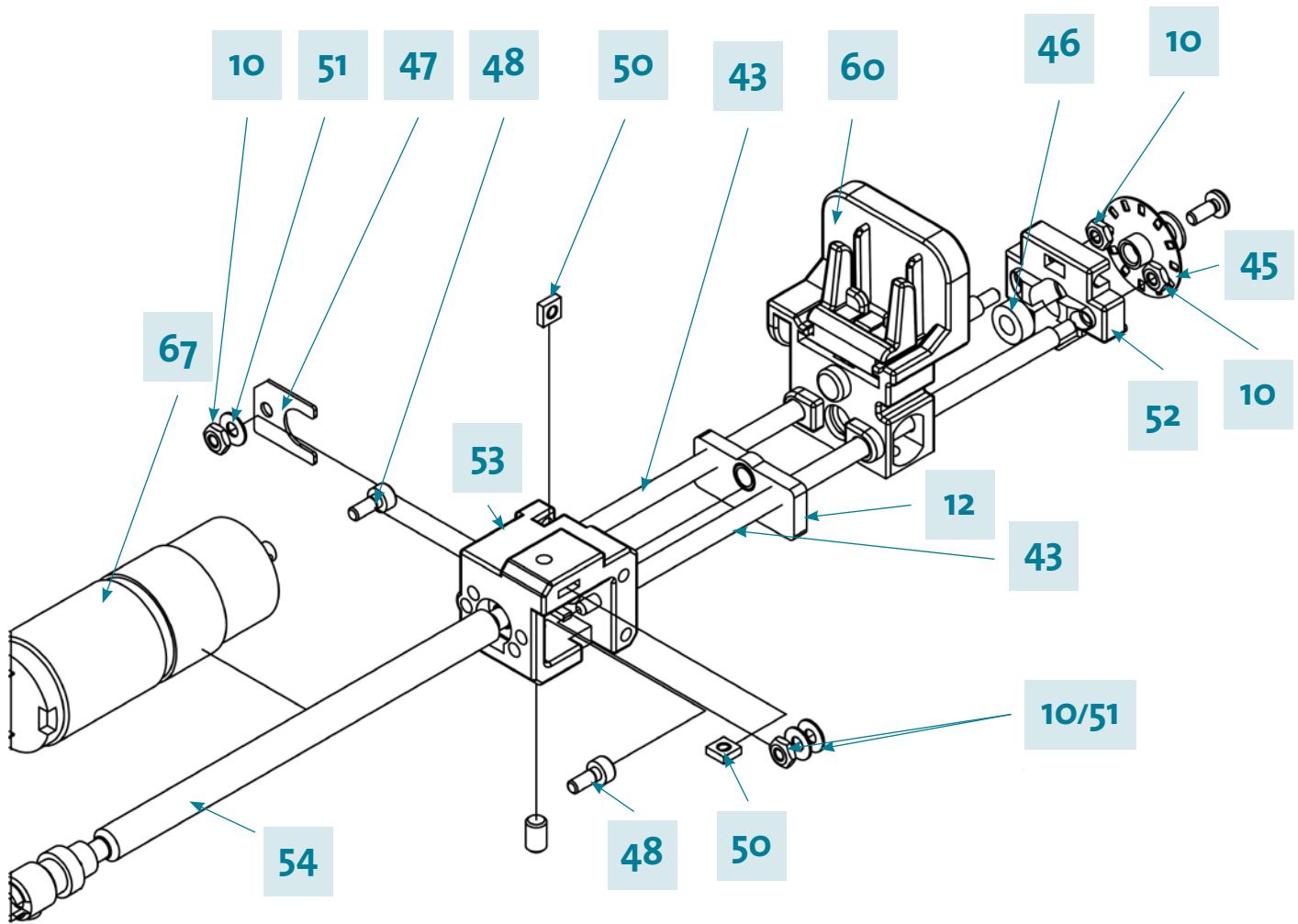
* When ordering a rear casing (#6) you will also need the following:
 300-045S (green) syringe label (#17)
 130-0005S battery label (#10)
 300-043S screw label (#16)

Front housing assembly



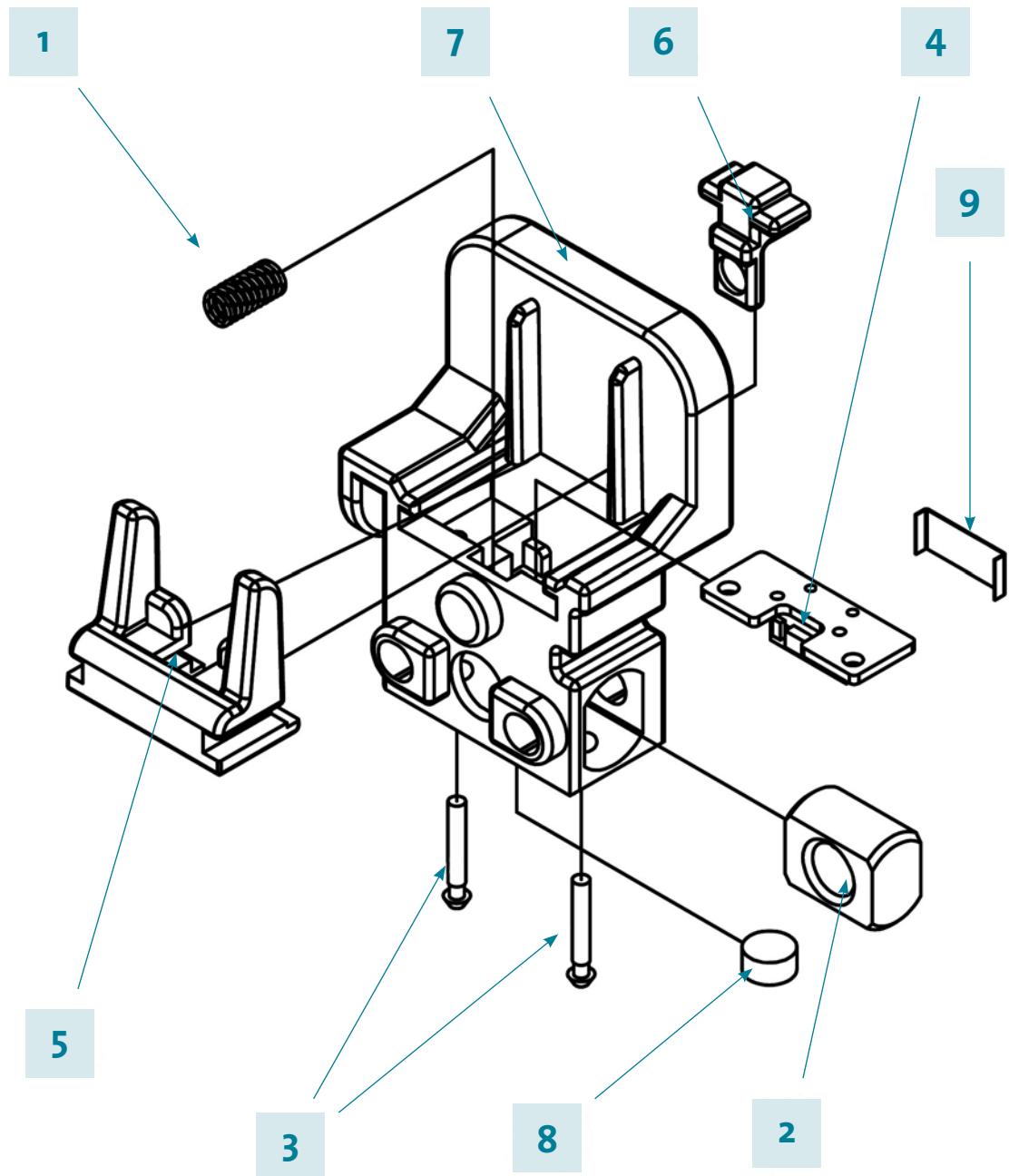
No	Part Number	Description	No	Part Number	Description
1	300-100S	Front housing	8	500-727S	Encoder PCB (part of main PCB)
2	500-300S	Display assembly	9	500-727S	Flat cable (part of main PCB)
3	500-727S	Main PCB	10	100-190SM	Gasket set
4	300-002S	Front spacer	11	100-006X	M2-hex nut
5	500-402S	Motor PCB	12	100-006X	M2-hex nut
6	200-000S	Block assembly	13	200-012	Screw M2x8, T34 motor block
7	200-070	Encoder PCB screws, M2x5	14	200-070	Screw M2x5

Block assembly



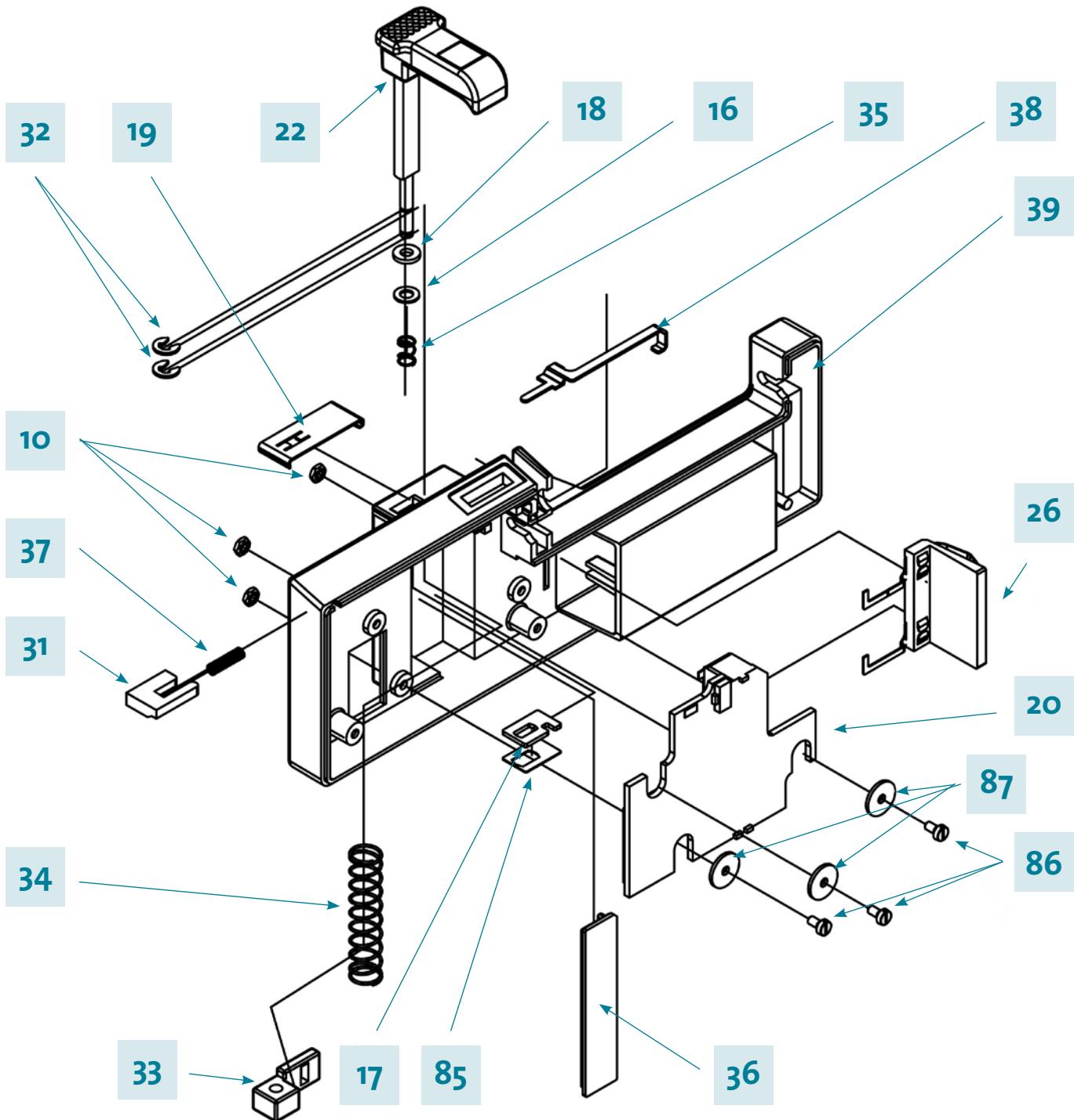
10	M2 hex nut	50	M2-square nut (regular thread)
12	Front gasket	51	M2 washer DIN 125A2.2
43	Leading bar	52	Rear block
44	Encoder spacer	53	Front block
45	Encoder	54	Screw assembly (includes screw, adapter, magnet and inner bearing)
46	Bearing, 3x6	60	Actuator assembly
47	Special washer	67	Motor assembly
48	Cylindrical head cap screw, M2x5		

Actuator assembly



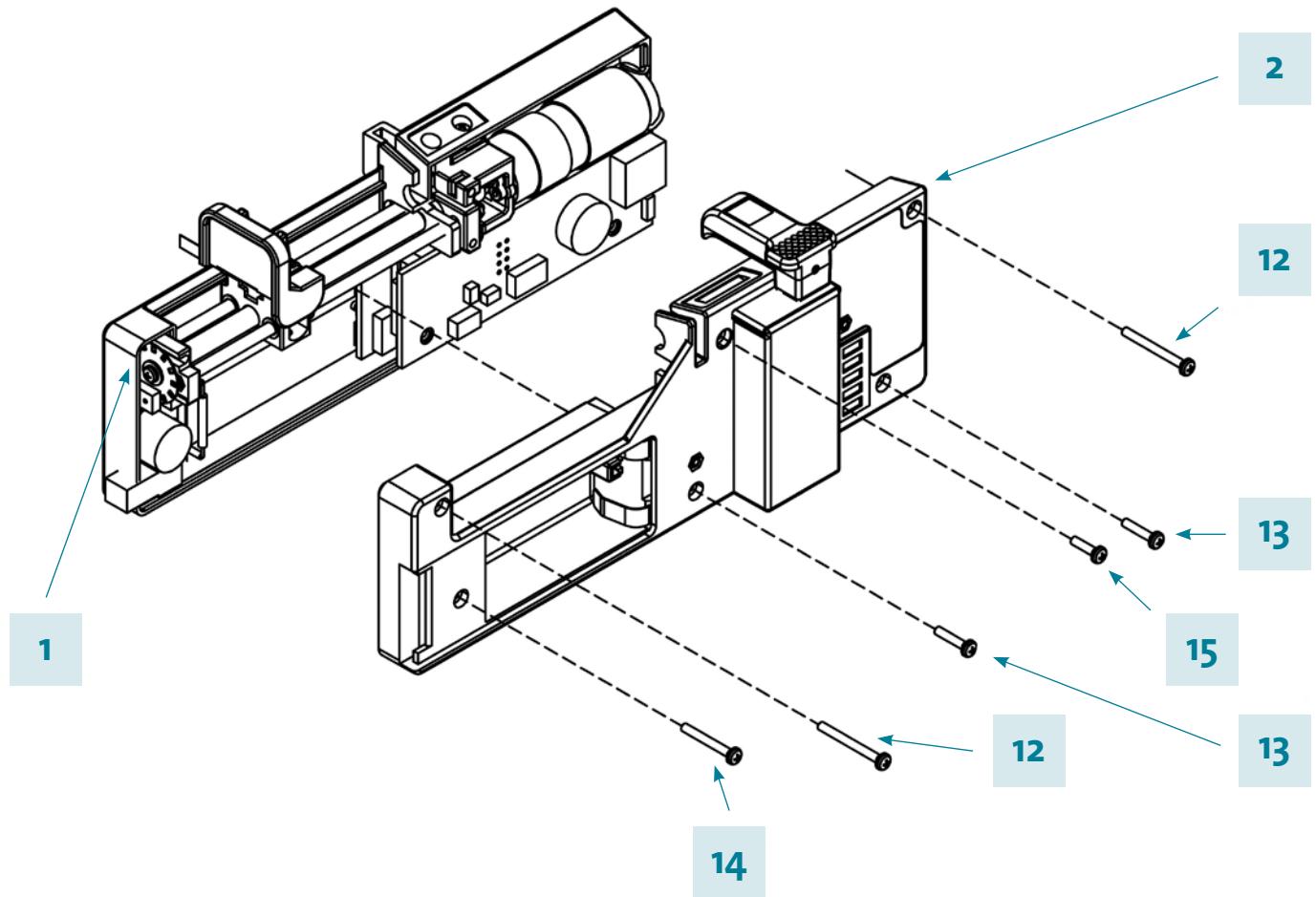
1	Spring for actuator	6	Syringe stopper 1 (actuator fixer 2)
2	Actuator nut	7	Actuator (actuator housing)
3	Contact pin	8	Magnet door (magnet)
4	Actuator PCB assembly	9	Insulation label for actuator
5	Syringe stopper 2 (actuator fixer 1)		

Rear assembly



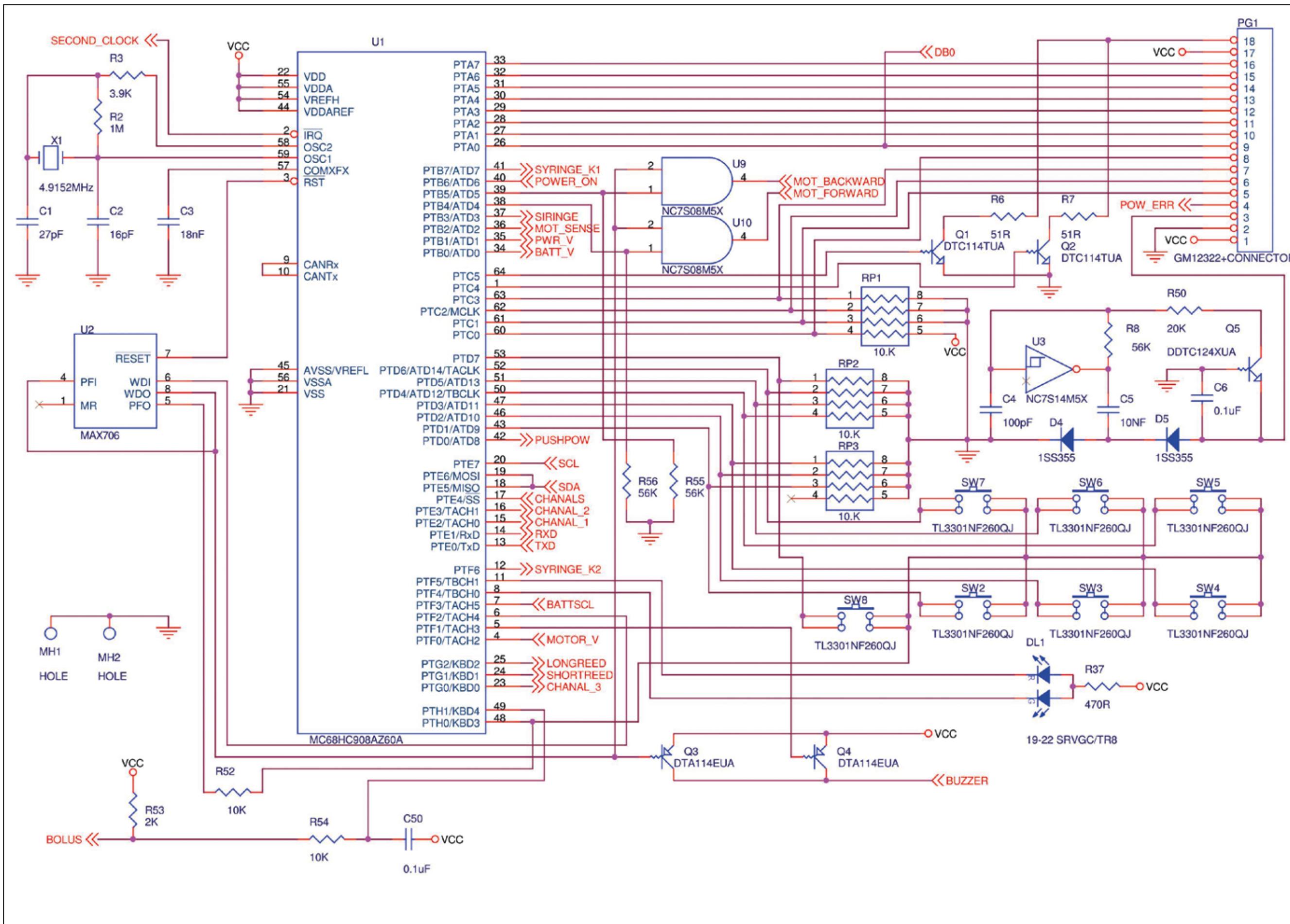
10	Hex nut, M2	33	Syringe holder driver
16	Washer M2-3, ISO 7092	34	Syringe holder spring 1
17	Sealing plate	35	Syringe holder spring 2
18	Sealing washer	36	Syringe holder cover
19	Metal cover sp	37	Spring locker
20	Rear PCB	38	Syringe sensor (collar sensor)
22	Syringe holder assembly	39	Rear housing
26	Contact wall assembly	85	Sealing latch
31	Spring housing	86	Slotted cheese-head screw, M2x4
32	Retaining washer (e-ring)	87	Washer M2, plastic (white)

Pump assembly

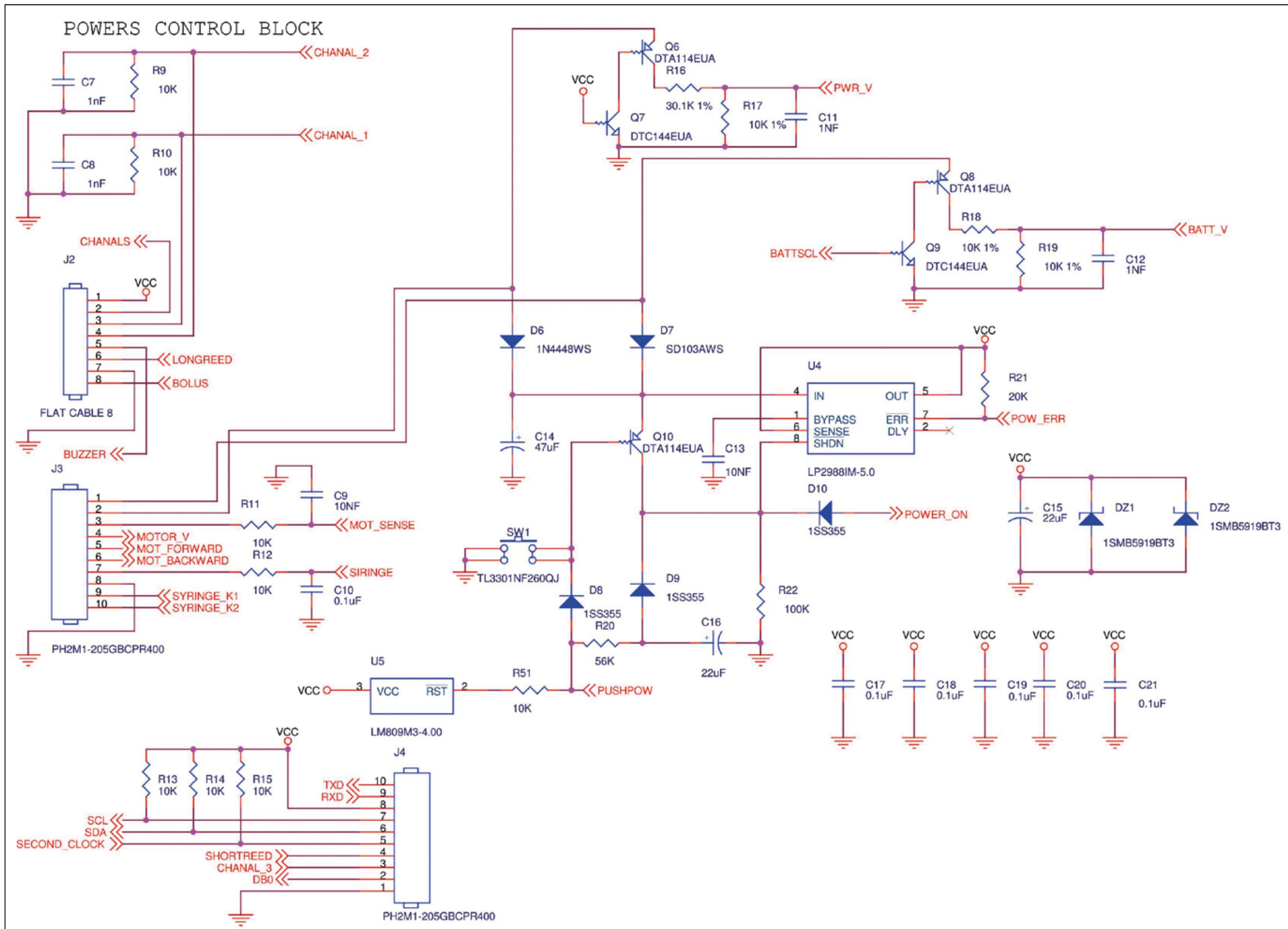


No	Description
1	Front housing assembly
2	Rear housing assembly
12	Recessed pan-head screw, M2x20
13	Recessed pan-head screw, M2x10
14	Recessed pan-head screw, M2x18
15	Recessed pan-head screw, M2x8

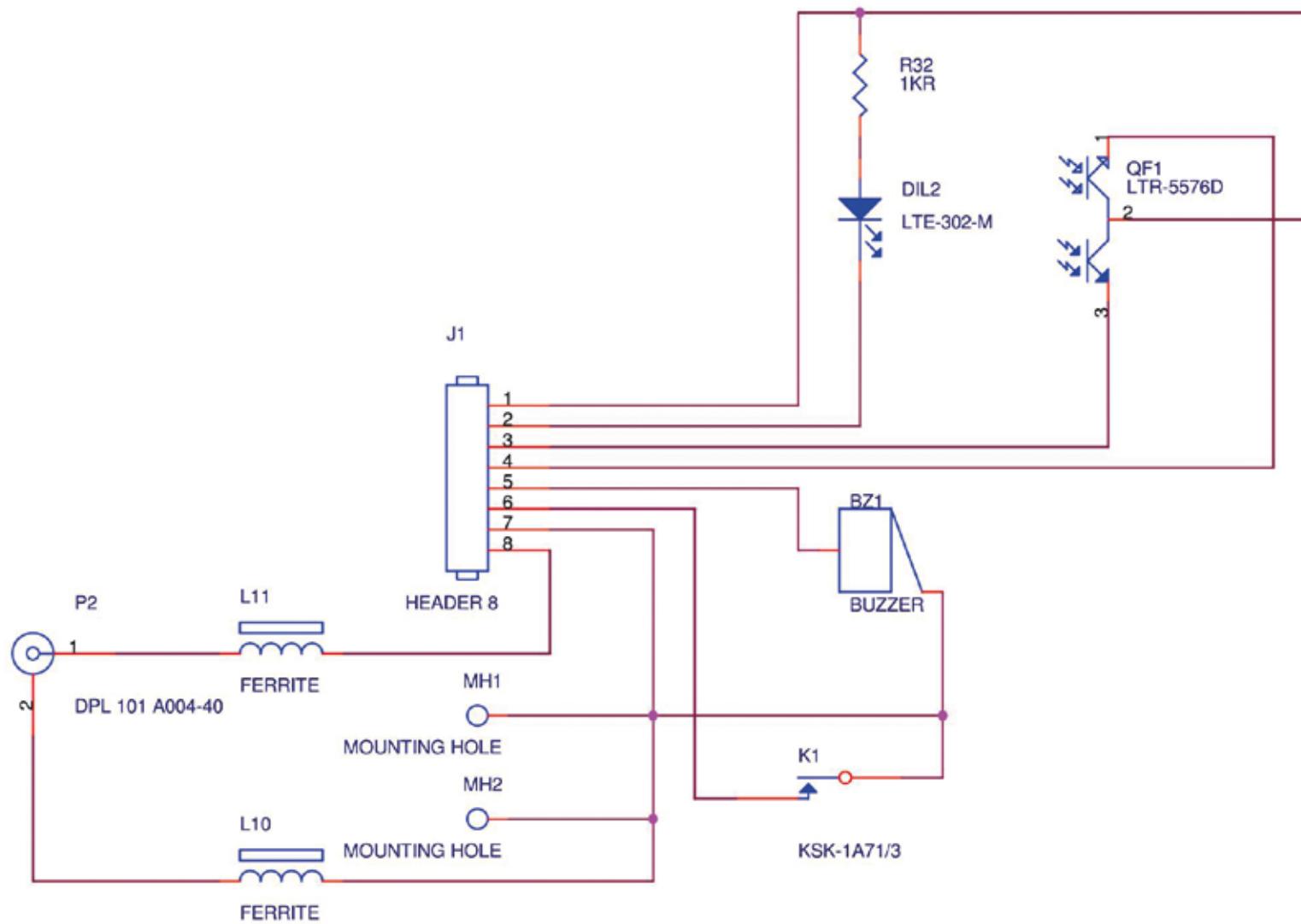
Main PCB wiring schematic



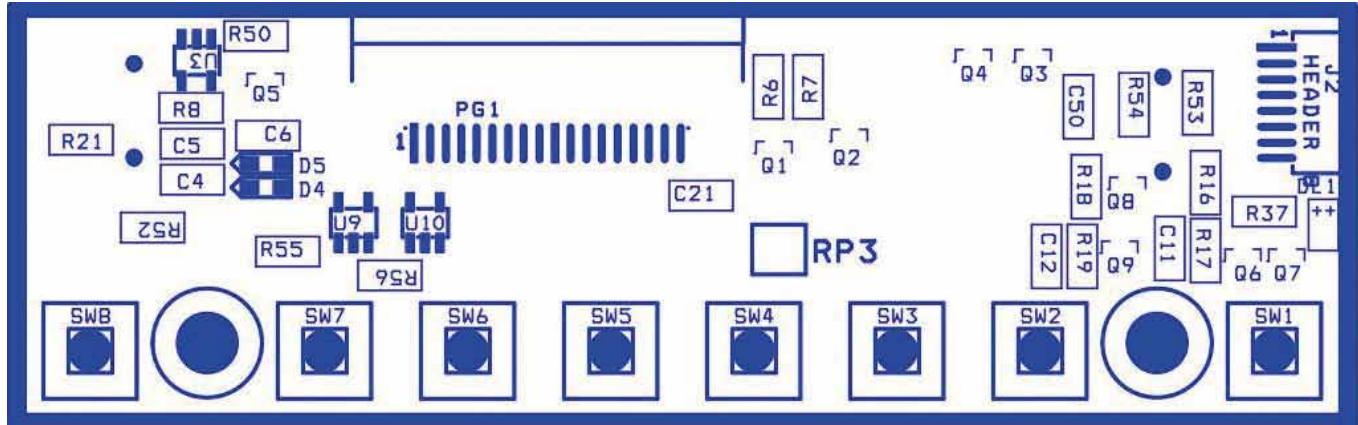
Main syringe PCB



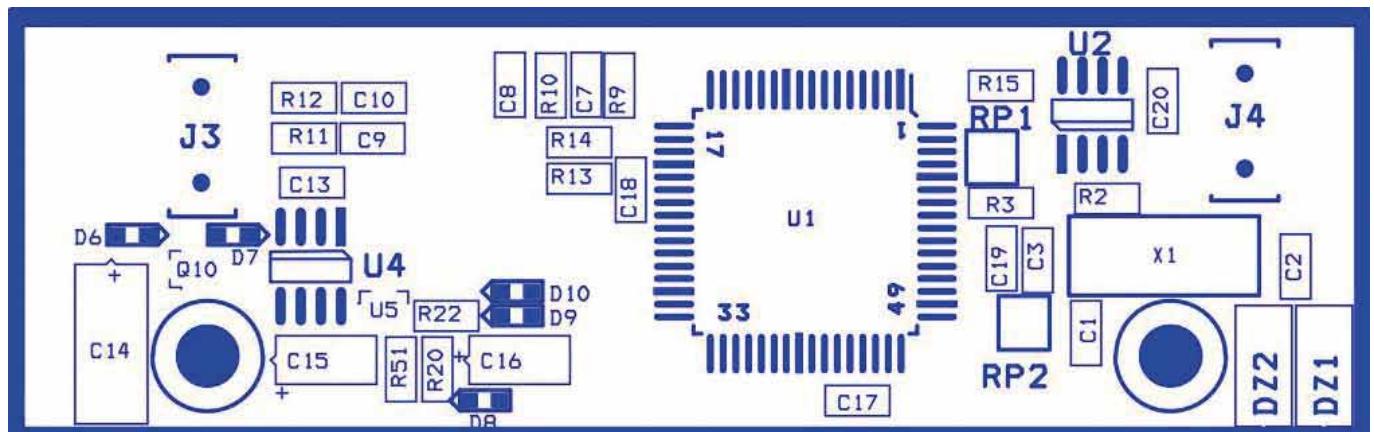
Encoder PCB wiring schematic



Main PCB layout

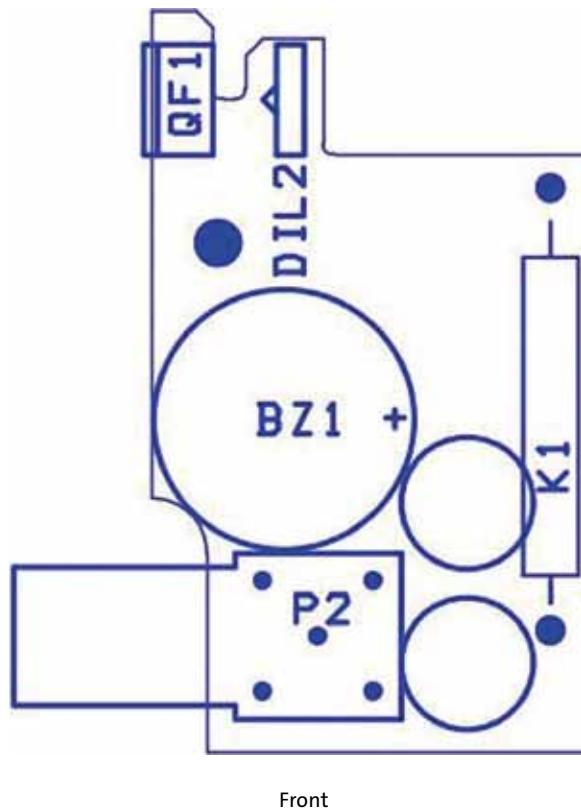


Front

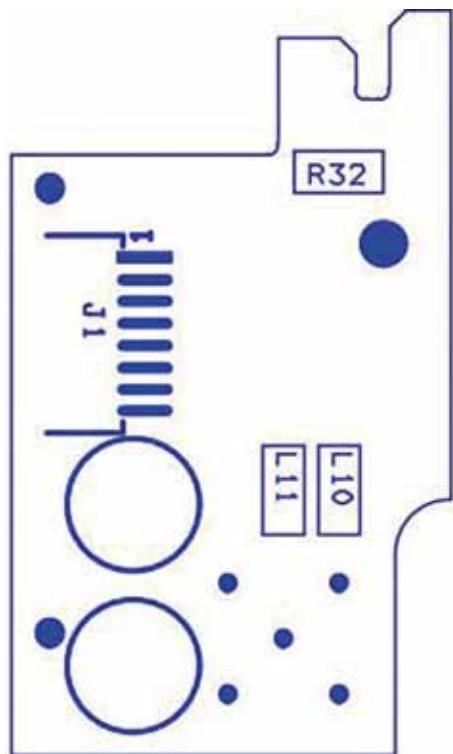


Back

Encoder PCB layout

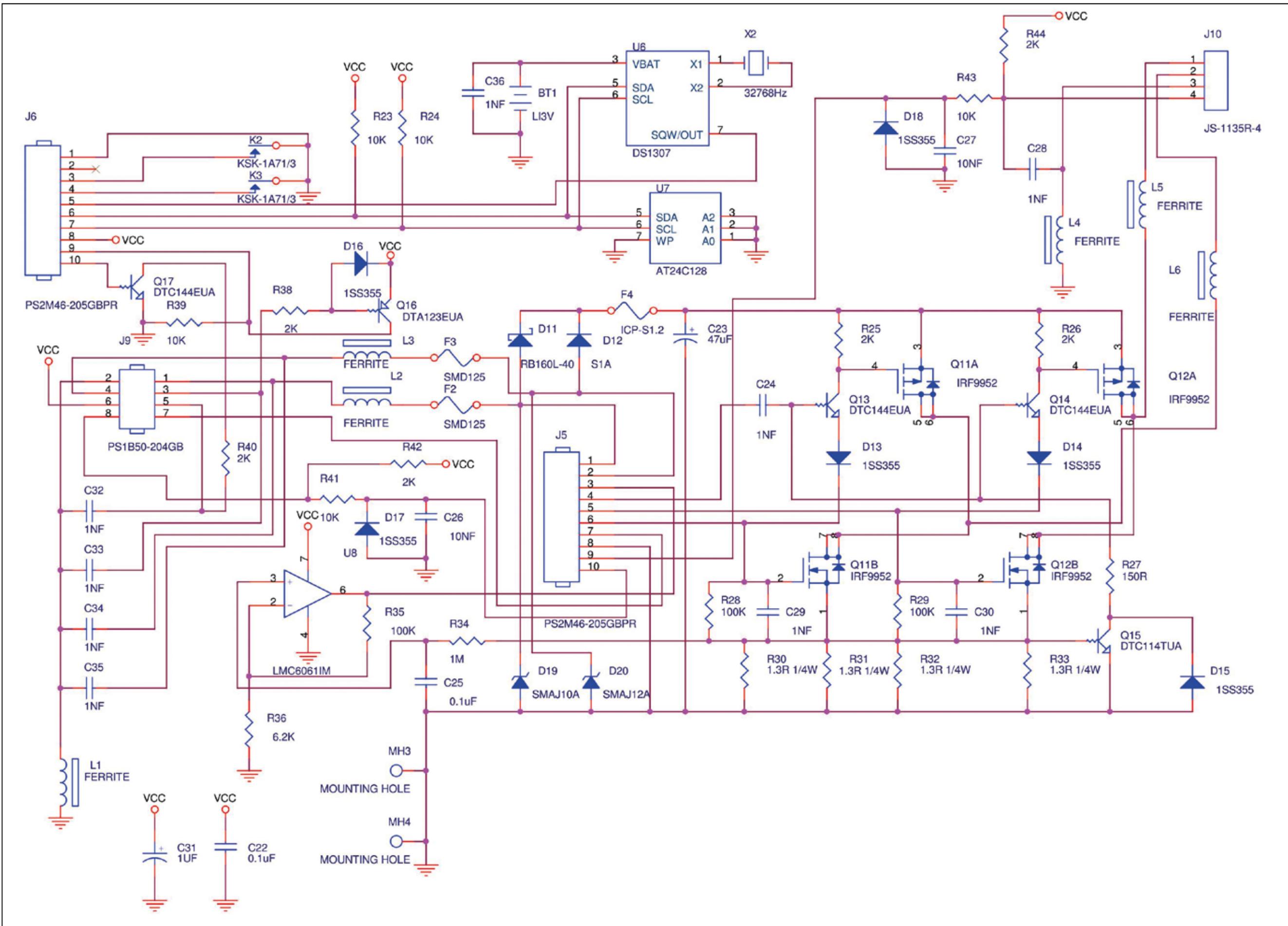


Front

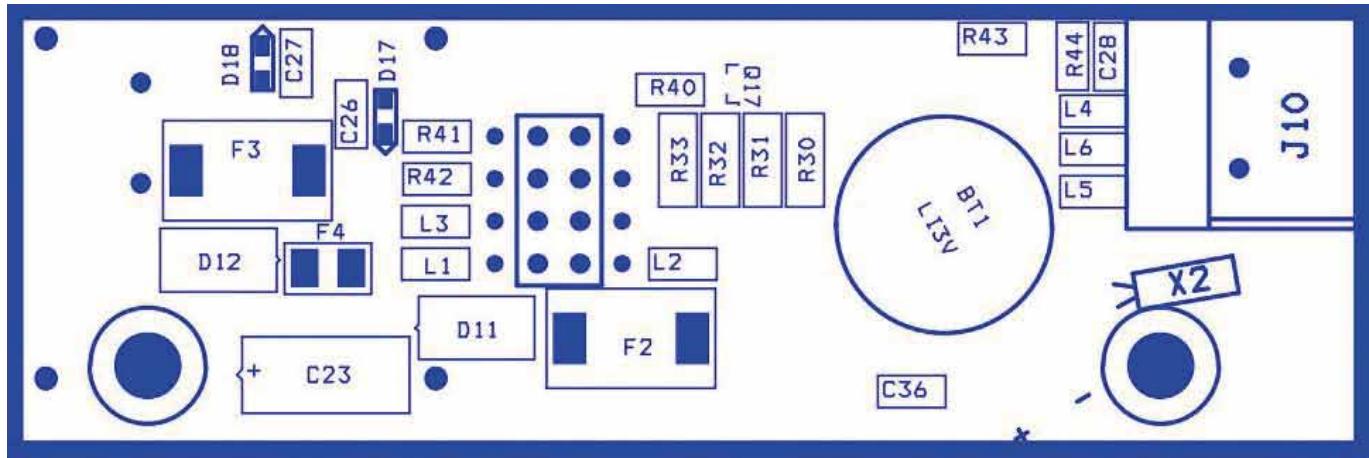


Back

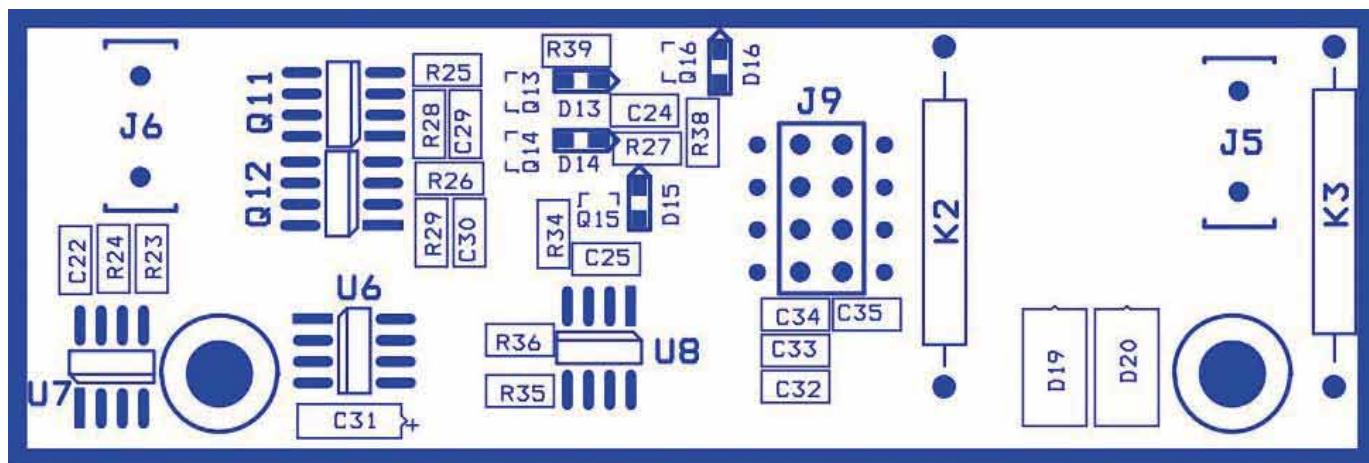
T34 motor PCB



Motor PCB layout

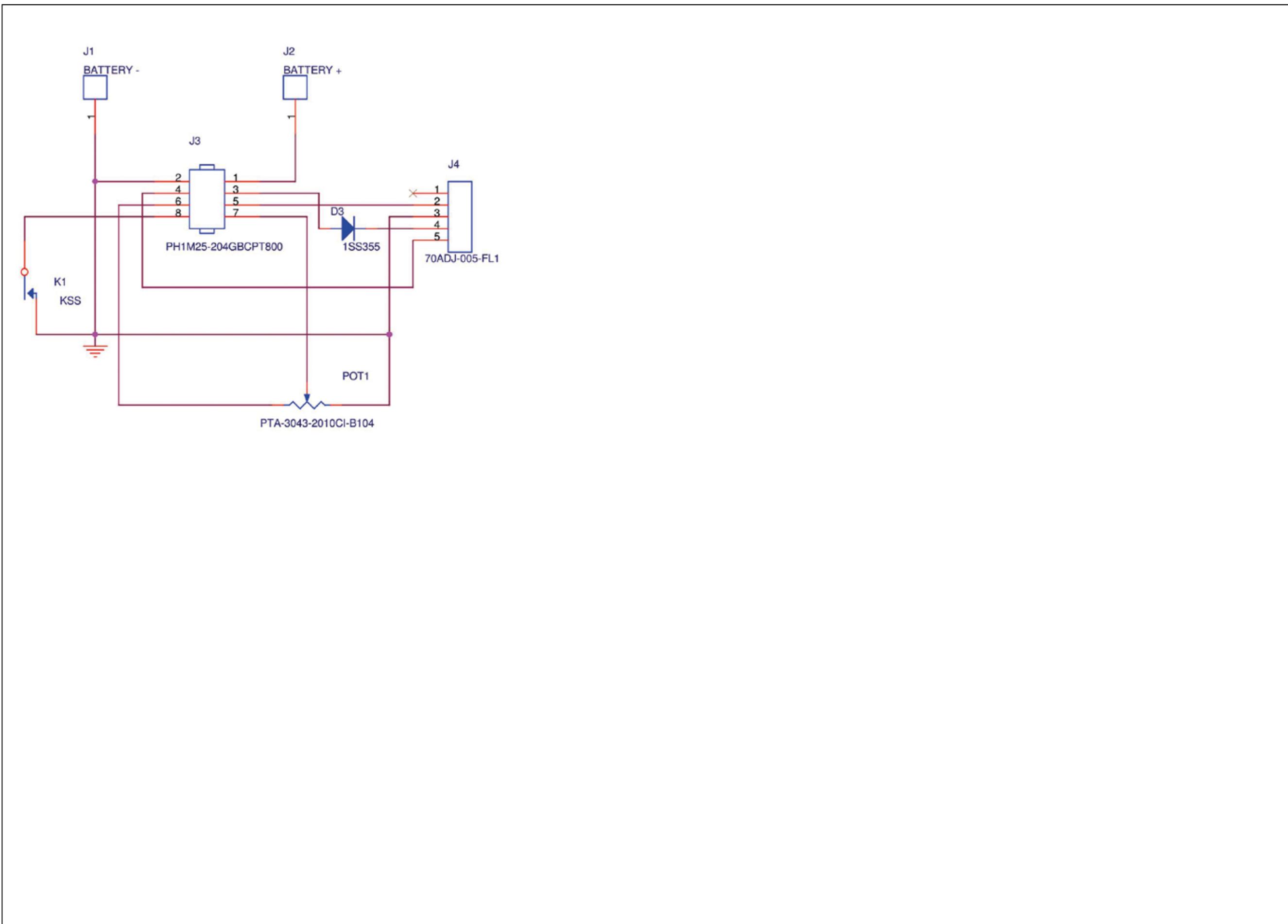


Front

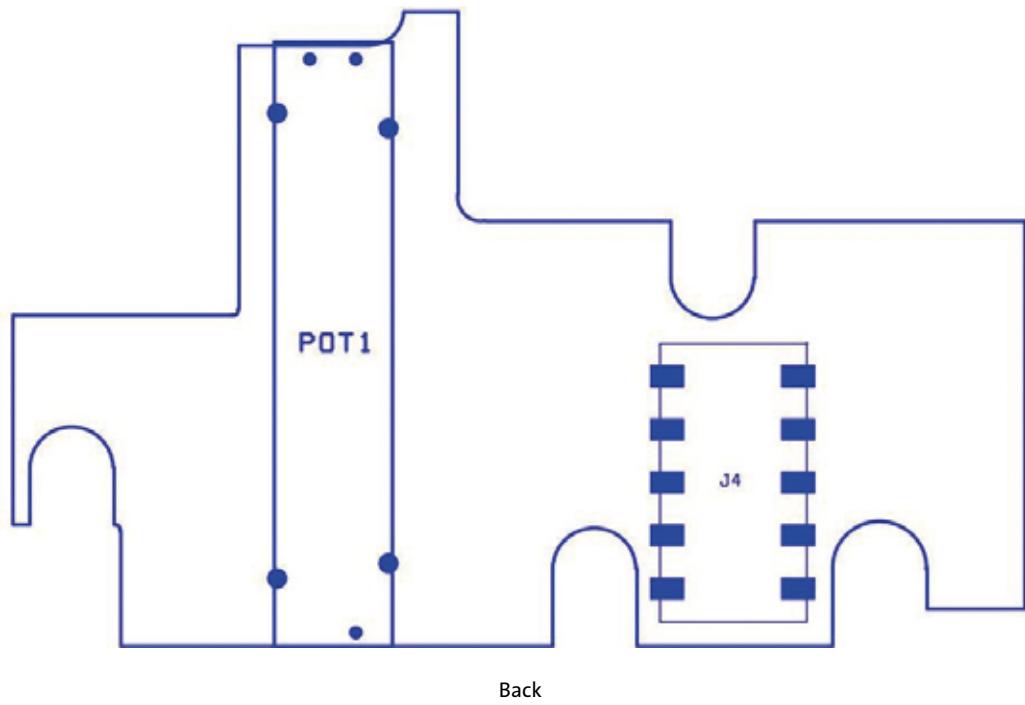
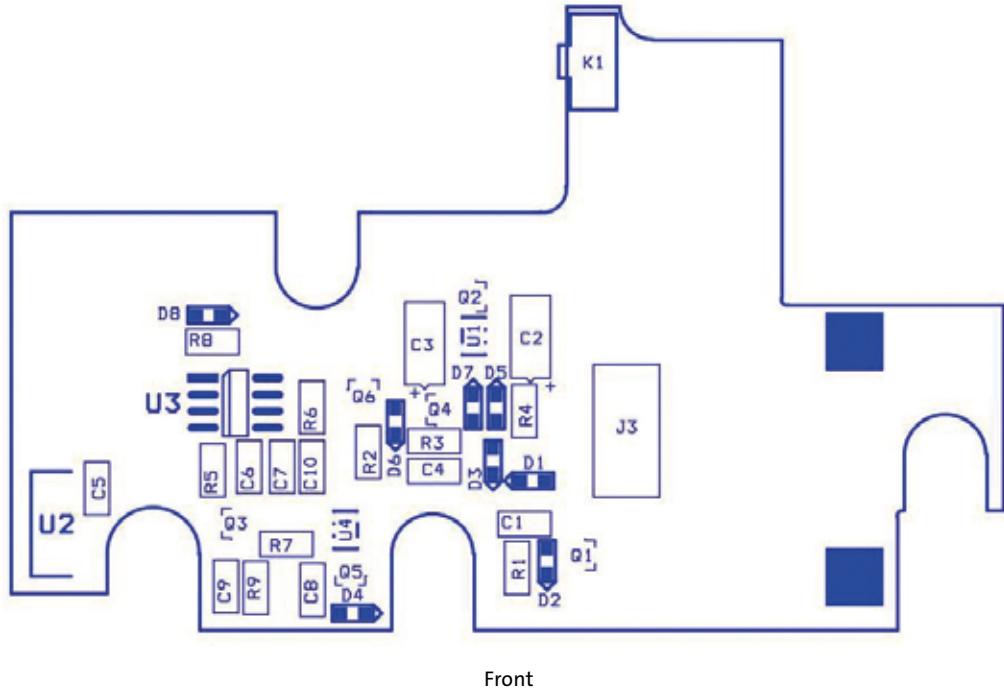


Back

Rear PCB



Rear PCB layout



Bills of material

SYRINGE PUMP MAIN PCB

DESCRIPTION	REFERENCE	QUANTITY	#
Syringe, main PCB, version 3	-	1	
Ceramic capacitor, 27pF, 5%	C1	1	
Ceramic capacitor, 16pF, 5%	C2	1	
Ceramic capacitor, 18nF, 10%	C3	1	
Ceramic capacitor, 100pF, 5%	C4	1	
Ceramic capacitor, 10nF, 10%	C5, C9, C13	3	
Ceramic capacitor, 10nF, 5%	C5,C9,C13	Alternative	
Ceramic capacitor, 0.1uF, 20%	C6,C10,C17,C18,C19,C20,C21	7	
Ceramic capacitor, 0.1uF, +80 -20% 50V		Alternative	
Ceramic capacitor, 1nF, 20%	C7,C8,C11,C12	4	
Ceramic capacitor, 1nF, 10%	C7,C8,C11,C12	Alternative	
Tantalum capacitor, 47µF, 16V	C14	1	
Tantalum capacitor, 22uF, 16V	C16,C15	2	
19-22SRVGC/TR8	DL1	1	
Diode Zener, 1SMB5919BT3	DZ1, DZ2	2	
Diode, 1SS355	D4, D5, D8, D9, D10,	5	
1N4448WS	D6	1	
SD103AWS-7-F	D7	1	
PH2M15-205GBCPR400	J3, J4	2	
Display connector, 18P 52271-1890	PG1	1	
Display connector, 18P FPC3AMR5-18TNB-18P	PG1	Alternative	
Transistor, DTC114TUA	Q2, Q1	2	
Digital transistor, PNP DTA114EUA	Q3, Q4, Q6, Q8, Q10,	5	
DDTC124XUA (diodes)	Q5	1	
Digital transistor, 47K NPN DTC144EUA ROHM	Q7,Q9	2	
Resistors, net 10K	RP1,RP2,RP3	3	
Resistor, 1M, 5%	R2,	1	
Resistor, 3.9KR, 5%	R3	1	
Resistor, 51R, 5%	R7,R6	2	
Resister, 56K, 5%	R8, R20,	2	
Resistor, 10K, 5%	R9,R10,R11,R12,R13,R14,R15	7	
Resistor, 30.1K, 1%	R16	1	
Resistor, 10K, 1%	R17, R18, R19,	3	
Resistor, 20K, 5%	R21	1	
Resistor, 470R, 5%	R37	1	
Resistor, 100K, 5%	R22	1	
Switch, TS-o6J-AHM	SW1, SW2, SW3, SW4, SW5, SW6, SW7, SW8,	8	

DESCRIPTION	DESCRIPTION	DESCRIPTION	#
Microprocessor, MC908A760ACFU	U1	1	
SP706EN	U2	1	
MAX706ESA	U2	Alternative	
NC7S14M5X	U3	1	
BU45584	U3	Alternative	
LP2988IM-5.0	U4	1	
LM809M3-4.00	U5	2	
NC7S08P5X	U9,U10	2	
Crystal, 4.9152MHz, M49L	X1	1	

SYRINGE PUMP MOTOR PCB

DESCRIPTION	REFERENCE	QUANTITY	#
Syringe motor PCB, Version 3		1	
Ceramic capacitor, 0.1µF, 20%	C22,C25	2	
Ceramic capacitor, 0.1µF, +80%-20%	C22,C25	Alternative	
Tantalum capacitor, 47µF, 16V	C23	1	
Ceramic capacitor, 1nF, 20%	C24	1	
Ceramic capacitor, 1nF, 10%	C24	Alternative	
Ceramic capacitor, 10nF, 10%	C26,C27	2	
Ceramic capacitor, 10nF, 5%	C26,C27	Alternative	
Diode Schottky, RB160L-40 1A	D11	1	
Diode, S1G	D12	1	
Diode, S1M	D12	Alternative	
Diode, 1SS355	D13,D14,D15,D16, D17,D18	6	
Fuse SMD-125-2	F2	1	
PS2M43-205GBPR	J5,J6	2	
PS1B50-204GB	J9	1	
Ferrite-FR BD 600R 25%	L1,L2,L3,L4,L5,L6	6	
IRF9952, double mosfet	Q11, Q12	2	
IRF7309	Q11, Q12	Alternative	
MMDF2Co3HD, double mosfet	Q11, Q12	Alternative	
Digital transistor, 47K, NPN DTC144EUA	Q13, Q14, Q17,	3	
Digital Transistor, 10K, NPN DTC114TUA	Q15	1	
Digital Transistor, PNP, DTA114EUA	Q16	1	
Resistor, 10K, 5%	R23,R24,R36,R38,R39,R41,R43	7	
Resistor, 2K, 5%	R25,R26,R40,R42,R44	5	
Resistor, 150R, 5%	R27	1	
Resistor, 100 K, 5%	R28,R29,R35	3	
Resistor, 1/4W, 2R 5%	R30,R31,R32,R33	4	
Resistor, 1M, 5%	R34	1	
DS1307Z	U6	1	
CAT 24WC128	U7	1	
24LC128-I/SN	U7	Alternative	

DESCRIPTION	REFERENCE	QUANTITY	#
LMC6061IM	U8	1	
Lithium battery, Li 3V	BT1	1	
Connector 4p male, 2.5mm 90°	J10	1	
Reed switch, KSK-1A71/3-BV13583	K3,K2	2	
Crystal, 32768Hz 2X6 15PPM	X2	1	

SYRINGE PUMP ENCODER PCB

DESCRIPTION	REFERENCE	QUANTITY	#
Syringe encoder PCB		1	
Buzzer, TDB 05	BZ1	1	
LTE-302-M	DIL2	1	
Reed switch, KSK-1A71/3-BV13583	K1	1	
LTR-5576D	QF1	1	
Resistor, 1KR, 5%	R32	1	

SYRINGE PUMP REAR PCB

DESCRIPTION	QUANTITY	#
Syringe rear PCB	1	
Connector, 70ADJ-005-FL1	1	
Connector, PH1M25-204GBCPT800	1	
Potentiometer, PTA-3043-2010CI-B104	1	

Software versions

device history

SOFTWARE VERSION	DATE CREATED	CREATED FROM	MODIFICATION/ REASON
CAT_010406	3 April 2006	CAT_020206	<ul style="list-style-type: none"> Disable high pressure recoverable alarm at maximum travel Failure alarm; increased security
NCAT010406	10 April 2006	CAT_010406	<ul style="list-style-type: none"> Failure alarm; increased security Change for syringe main PCB ver 1, 2. (keyboard interrupts, keyboard read, watchdog time test) Failure alarm; increased security Default start position 1mm lower from maximum travel
NCAT020406	14 May 2006	NCAT010406	<ul style="list-style-type: none"> During preloading reduce rate 2mm before maximum travel (was 1mm) Terminate preloading execution in case of mechanical problem
NCAT010506	21 May 2006	NCAT020406	Correct motor current to force calculation formula for Faulhaber motor
NCAT011106	November 2006	NCAT010506	Divide by four the time between motor pulses during creation of event data, or leave at previous event data format. Change accordingly the Event data screen (display109) to display correct actual rate. Enable communication module only at special modes ('Preloading') Add Technician acoustic alarm test; also test of communication transmission frequency
NCAT011206	December 2006	NCAT011106	At communication make 2 stop bits in transmission and 1 stop bit in receiving for IR communication stability. Communication module remain enabled at Pump Unattended
NCAT010407	10 April 2007	NCAT011206	Communication algorithm continue: change technician data, change setting
NCAT010507	9 May 2007	NCAT010407	If distance to end of program > 15 mm, Near End Disabled Time to end > 15 minutes, Near End Disabled If distance to end of program < 2 mm, Near End Enabled Near End beeps first time at first near end detection, then every 256 seconds. Volume changed in the event log should be with unidentified syringe type.
NCAT010208	11 February 2008	NCAT010507	Increase free move rates to 5 mm/sec, 1 mm/sec, 0.1 mm/sec, to enable implementation of 1ml length limits
NCAT020208	21 February 2008	NCAT010208	<ul style="list-style-type: none"> Allow Monoject syringe without collar Change near end screen timing Change display 16 Correct update minimum titration Change occlusion alarm procedure
NCAT030208	22 February 2008	NCAT020208	<ul style="list-style-type: none"> Add service interval for Calibration Due In date Technician and set op code (level 1) adjustable
NCAT010308	5 March 2008	NCAT030208	<ul style="list-style-type: none"> With Monoject always to warn of collar sensor disabled Save keypad lock and switch on with keypad locked in case it was at Keypad Locked Change message on display warning of collar sensor disabled Correct Technical syringe data shown on Brand Selection screen
NCAT020308	9 march 2008	NCAT010308	<ul style="list-style-type: none"> Keypad Lock block No key also During operation, allow stop by pressing No key at Keypad Locked Not allow other syringe type than last at Keypad Locked Not to perform Preloading at Keypad Locked
NCAT030308	9 March 2008	NCAT020308	Increase touch current to 150mA

SOFTWARE VERSION	DATE CREATED	CREATED FROM	MODIFICATION/ REASON
NCATo40308	25 March 2008	NCATo30308	Correct Monoject recognition
NCATo50308	27 March 2008	NCATo40308	<ul style="list-style-type: none"> Occlusion pressure factory settings changed from 540 to 720mmHg (first programmed remain 540 because calibration procedure require 540mmHg) In technician access code changes add top line 'Enter Tech Code' and bottom line 'Change; Press Yes'
NCATo10408	8 April 2008	NCATo50308	<ul style="list-style-type: none"> To solve Encoder 2 Fail during Travel Test and Revolution Encoder fail during moving on 5mm/sec Change encoder false interrupt to recognize direction
NCATo20408		NCATo10408	<ul style="list-style-type: none"> Rename 50ml to 60ml Change step algorithm for rate titration for American market
NCATo10608 **('C')	26 June 2008	NCATo20408	<ul style="list-style-type: none"> Rename 60ml to 50/60ml Change first programmed pressure alarm level to 720mmHg ('Modify alarm modes and start-up for nuisance alarm uncontrolled moving')
NCATo11108	11 November 2008	NCATo10608	<ul style="list-style-type: none"> Make serial number range from 'Soooooooo' to 'S16777215' Enable alarm at Fatal Error
NCATo20309	2 March 2009	NCATo11108	<ul style="list-style-type: none"> Unlock the info mode with set up code Disable starting motor pulse at enabling Correct Time Remaining display during operation Maximum Purge setting 2.0ml Three diameter calibration points
NCAT11009C	1 October 2009	NCATo11108	<ul style="list-style-type: none"> Add rate setting Disable Starting Pulse Maximum purge setting 2.0ml Add third diameter calibration point Correct calibration and setting range comparison procedure Add Rate Setting and Access Code to communication protocol Adjustable Rate setting access code Modify checking for No Rotation Detected Correct conversion coefficient from psi to mmHg Detect third encoder fail Correct month service interval saving Add service due event and Yes key confirmation Correct unselected syringe data event save Modify alarm modes and start up for nuisance alarm uncontrolled moving
NCAT31009C	3 October 2009	NCAT11009C	Modify alarm modes and start-up for nuisance alarm uncontrolled moving
NCAT41009C	4 October 2009	NCAT11009C	<ul style="list-style-type: none"> Modify alarm modes and start-up for nuisance alarm uncontrolled moving Same to NCATo108 memory map Remove third diameter calibration point (outsize K3) Move rate code (access rate) Move rate setting (bdefrate) Add check for motor drive fail short
NCAT51009C	5 October 2009	NCAT41009C	<ul style="list-style-type: none"> Modify alarm modes and start up for nuisance alarm uncontrolled moving Same as NCATo10608 calibration and setting memory map
NCAT10410C	1 April 2010	NCAT51009C	Pressure calibration red point reduced to 40 from 50 on factory pressure test

NOTE The C version of the Bodycomm software has an improved Alarm Handling and Watchdog Circuit, to reduce nuisance alarms on the device.

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