S4000 Cx3 ADEC/SAM (for SAM SW version 40012_A3)
Troubleshooting starting and stopping the engine

For engines Series 4000-03 for mining application two possibilities exist to wire the start/stop signals:

1) Start/stop wired to the ADEC
2) Start/stop wired to SAM (start and stop signal are transmitted via CAN)

1) Start stop wired to ADEC

Required cable connections

Start and stop signal are wired in the X1 connector (vehicle interface harness, drawing XZ00E50000015).

Stop signal (ADEC input DI 1)
X1 pin 28: GND
X1 pin 43: +24 V

This input is configured as an “active low” input (default setting). The stop is active if pin 43 is not connected to 24 V (safety feature, engine is stopped when wire break!).

Start signal (ADEC input DI 7)
X1 pin 22: GND
X1 pin 37: +24 V

This input is configured as an “active high” input (default setting). An engine start is requested when 24V are applied to pin 37.

2) Start & stop wired to SAM

Required cable connections

Start and stop signal are wired to the SAM (connector X19, drawing XZ00E50000016). The SAM offers an additional feature called start interlock (connector X3).

Stop signal (SAM input P_IN 1)
X19 pin 5: +24 V

This input is configured as an “active low” input (default setting). The stop is active if pin 5 is not connected to 24 V (safety feature, engine is stopped when wire break!).

The SAM stop function is only allowed to be deactivated if the ADEC stop function is used with default settings.

Parameter 531:	0 - SAM engine stop function deactivated
Parameter 22:	change from 0 to 256 to deactivate SAM channel 41 If parameter 22 is not 0 before change convert the parameter’s decimal value to binary value → bit 8 has to be activated

Start signal (SAM input P_IN 3)
X19 pin 7: +24 V

This input is configured as an “active high” input (default setting). An engine start is requested when 24V are applied to pin 7.

This function can be configured with the following SAM parameter:

Parameter 530:
0 - SAM engine start function deactivated
1 - SAM engine start function activated: hardwired (X19, pin 7 → default setting)
2 - SAM engine start function activated: CAN
3 - SAM engine start function activated: hardwired and CAN

Start interlock (SAM input B_IN 1)
X3 pin 10: GND
X3 pin 9: +24 V

This input is configured as an “active low” input (default setting). The start interlock function is active if pin 9 is disconnected from power supply - an engine start is not possible.

If the start interlock feature is not required the function can be deactivated in the SAM software:

Parameter 507:
0 - start interlock function not active
1 - start interlock function active: hardwired (default setting)
2 - start interlock function active: CAN
3 - start interlock function active: hardwired and CAN

Remark: If the start interlock feature is used and the input recognizes “start interlock active” no start request message is broadcasted on the CAN bus (refer to 2.1090.201 below).

Ready for start lamp (SAM output BT_OUT 9)
X17 pin 11: +24 V

The ready for start lamp is a recommended feature to display the status of the engine before start and during start sequence (refer to chapter 3):

- Lights up if an engine start can be initialized (START possible, leads to prelubrication)
- Flashes while the oil priming pump is in operation.
- Lights up again once the required oil pressure is built up and the engine can be started (START now leads to starting of the engine).
- Goes out if the engine speed increases to over 300 rpm.

Remark: With SAM software version 40012_A3 the “Ready for start lamp” does not indicate if stops or the start interlock are active. For this reason an activated ready for start lamp does not guarantee starting of the engine.

DiaSys (connected to ADEC):

Stop signals:

2.7001.001	Stop Activated	Engine stop is activated. The reason can be found in PV 2.7001.002 an following.
2.7001.002	Stop Button	Manual stop request by ECU button, configurable to any ECU binary input by Binary Input Configuration.
2.7001.003	Stop FBFE	A stop was performed by the injection system (loss of synchronisation and no available redundancy).
2.7001.004	Stop CAN	Result of all manual stop inputs via CAN (SAM).
2.7001.005	Stop Protection	Result of all stop requests by the protection modules
2.7001.007	ESI Input activated	ESI input is activated
2.7001.008	External Stop Activated	Stop activated by external signal (stop button, CAN (SAM))
2.7001.010	Automatic Engine Stop	Security system or engine stalling has stopped the engine
2.7001.011	CAN Request Engine Stop 1	Request of engine stop via CAN (SAM)

2.7001.001 indicates that a stop is activated (for source of stop check PVs 2.7001.002 to 2.7001.011)
2.7001.002 indicates that stop on ADEC DI 1 is activated
2.7001.011 indicates that stop on SAM P_IN 1 is activated

Start signal

2.1090.001	Ignition input IGI activated	IGI input is activated
2.1090.010	Engine Start Clearance	Engine may be started. Bit 0 of the Engine Starting States PV.
2.1090.050	Engine Start Requested	Result of all engine start requests.
2.1090.051	Engine Start Button	Input signal from ECU7. 0 = Start button not pushed. 1 = Start button pushed. Configurable to any ECU7 binary input by Binary Input Configuration.
2.1090.201	CAN Engine Start (LOP)	Starting request via CAN from LOP device (SAM).

2.1090.001 must be “1” to start engine
2.1090.010 must be “1” to start engine
2.1090.050 indicates a start request but not the source of the start request (check PV 2.1090.051 and 2.1090.201)
2.1090.051 indicates that start on ADEC DI 7 is activated
2.1090.201 indicates that start on SAM P_IN 3 is activated (transmitted via CAN bus)

DiaSys (connected to SAM):

Start interlock:

The start interlock can not be checked on the ADEC.

PV 005020 (SAM) if “1” start interlock active, engine can not be started
if “0” engine start is possible

3) Start sequence and prelube/starter activation

The start sequence for Series 4000-03 engines is controlled by the ADEC. The ADEC checks for conditions if a engine start is allowed and controls activation of prelube pump and starter.

Start sequence (further details in attachment 5):

1. Start signal applied (if start clearance, start sequence activated)
2. Prelube pump activated until oil pressure ok
3. Starter activated

Prelube pump

The prelube pump is connected to transistor output TO3 in the X2 sensor harness (drawing XZ00E50000347).

Prelube pump on signal (ADEC output TO3)

X2 pin 35: GND
X2 pin 13: +24 V

Starter relay activation (no POM installed)

If no POM is installed the starter relay is activated by the transistor output TOP4 in the X1 harness.

Starter on signal (ADEC output TOP4)

X1 pin 9: GND
X1 pin 10: +24 V

Starter activation (POM installed)

If a POM is installed the starter is activated by the POM. The signal to the starter is wired in the POM harness (X21, drawing XZ00E50000134 and XZ00E50000136).

Starter on signal (POM output TOH1/TOH2)

X21 pin 1: +24 V (TOH1 to starter A side, XM1A pin 1)
X21 pin 2: +24 V (TOH2 to starter B side, XM1B pin 1)

DiaSys (connected to ADEC):

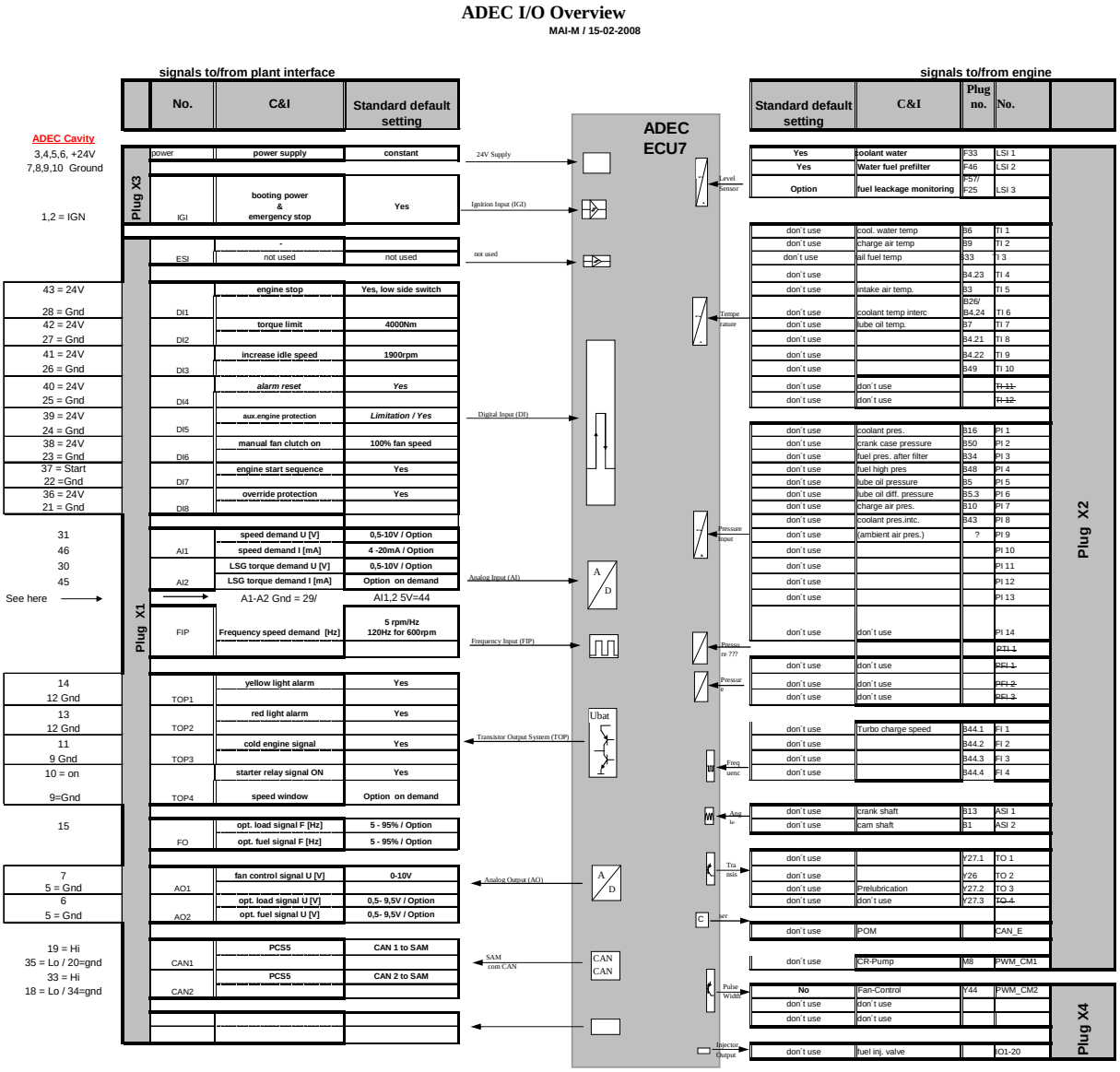
Start sequence

2.1090.012	Starting in Progress	Info bit that starting is in progress. 0 = No starting in progress. 1 = Starting in progress. Bit 2 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021).
2.1090.013	Starter ON	Info bit that starter is running. 0 = Starter is not running. 1 = Starter is running. Bit 3 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.014	Prelubrication Pump ON	Activate lubrication unit via CAN.

		0 = Lubrication unit OFF. 1 = Lubrication unit ON. Bit 4 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.015	Prelubrication Indication	Indication of Prelubrication, reflects activity of Prelub pump. 0 = Prelubrication pump off. 1 = Prelubrication in progress. Bit 5 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.017	Starter Speed Reached	Info bit that engine has reached the projected Starter Speed. 0 = Starter speed not reached. 1 = Starter speed reached. Bit 7 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.018	Starter Release Speed Reached	Info bit that engine has reached the projected Starter Release Speed. 0 = Starter release speed not reached. 1 = Starter release speed reached. Bit 8 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.019	Idle Speed Reached	Info bit that engine has reached the projected Engine Idle Speed. 0 = Engine idle speed not reached. 1 = Engine idle speed reached. Bit 9 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.020	Start Aborted	Info bit. 0 = OK. 1 = Start has been aborted. Bit 10 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.021	Restarting	Info bit. 0 = OK. 1 = Engine is beeing restarted after engine failed to reach projected Starter Speed within the projected Starter Time Interval. Bit 11 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.024	Engine Start Instruction	Set when engine start request is valid. Signaled back via CAN to Start (Button) Indication Light. Bit 14 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.026	Start Aborted T-Preheat	Info bit. 0 = OK. 1 = Limit 1 of T-Preheat has not yet been reached. Starting procedure is aborded due to this condition. Bit 16 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.027	Start Aborted P-Prelubrication	Info bit. 0 = OK. 1 = Priming limit of T-Lube Oil has not yet been reached. Starting procedure isaborded due to this condition. Bit 17 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..

2.1090.012 indicates that start sequence is in progress
2.1090.014 indicates that the prelube pump is on (TO3 activated)
2.1090.013 indicates that starter is on
w/o POM: TOP4 activated
w/ POM: TOH1 and TOH2 activated

Attachment 1: I/O overview ADEC



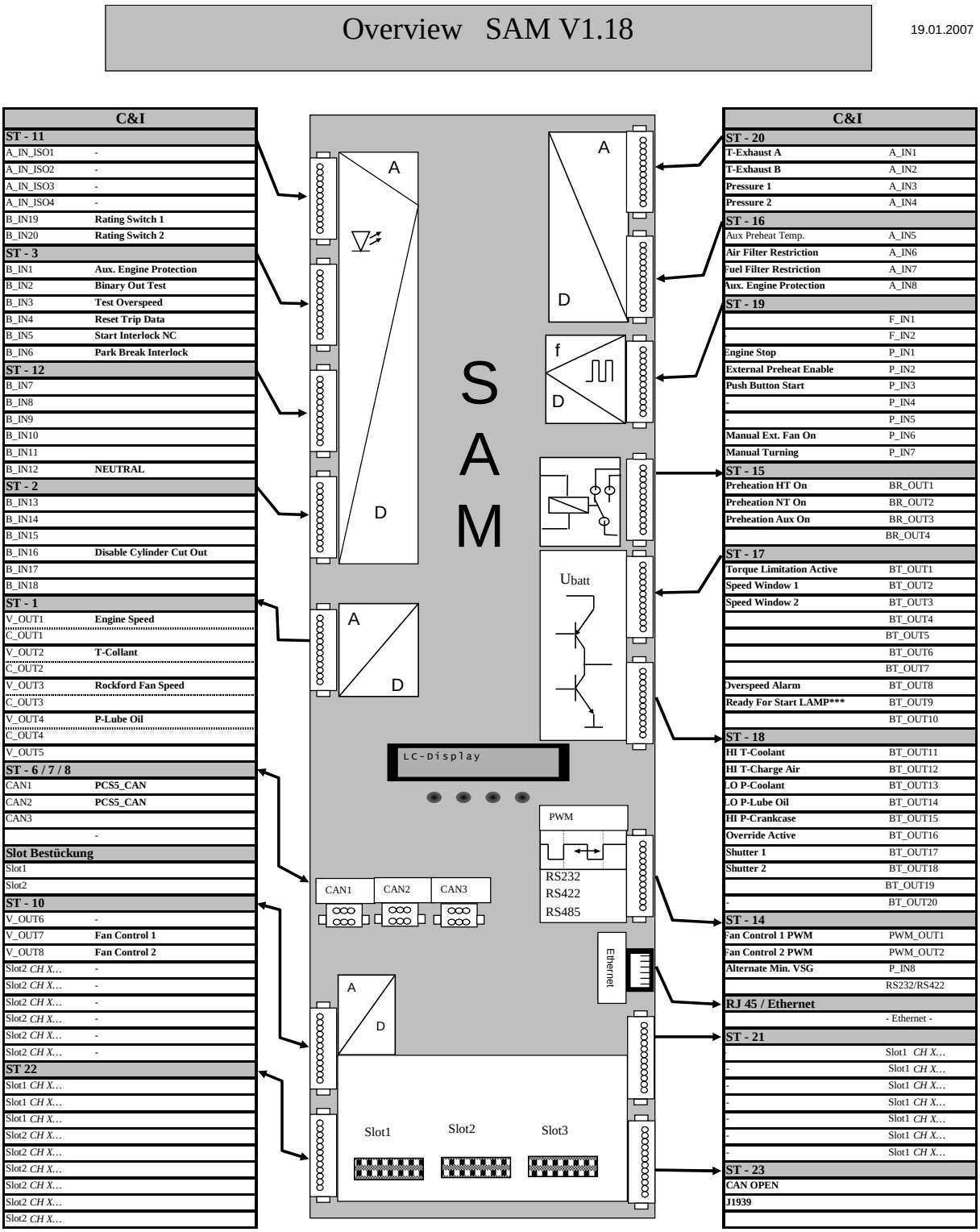
ADEC rule overview

Digital Inputs (ADEC):			***Rule 3-1-X***
DI 1 "Engine Stop"	DI 1 activated	**YES**	Rule 3-1-2-1
	Wire break monitoring active	**NO**	Rule 3-1-1-1
	SD default Value	**NO**	Rule 3-1-1-1
stop engine => active low	**Active high**	**NO**	Rule 3-1-3-1

DI 7 "Engine Start Sequence"	DI 7 activated	**YES**	Rule 3-1-2-7
	Wire break monitoring active	**NO**	Rule 3-1-1-7
	SD default Value	**NO**	Rule 3-1-1-7
	Active high	**YES**	Rule 3-1-3-7

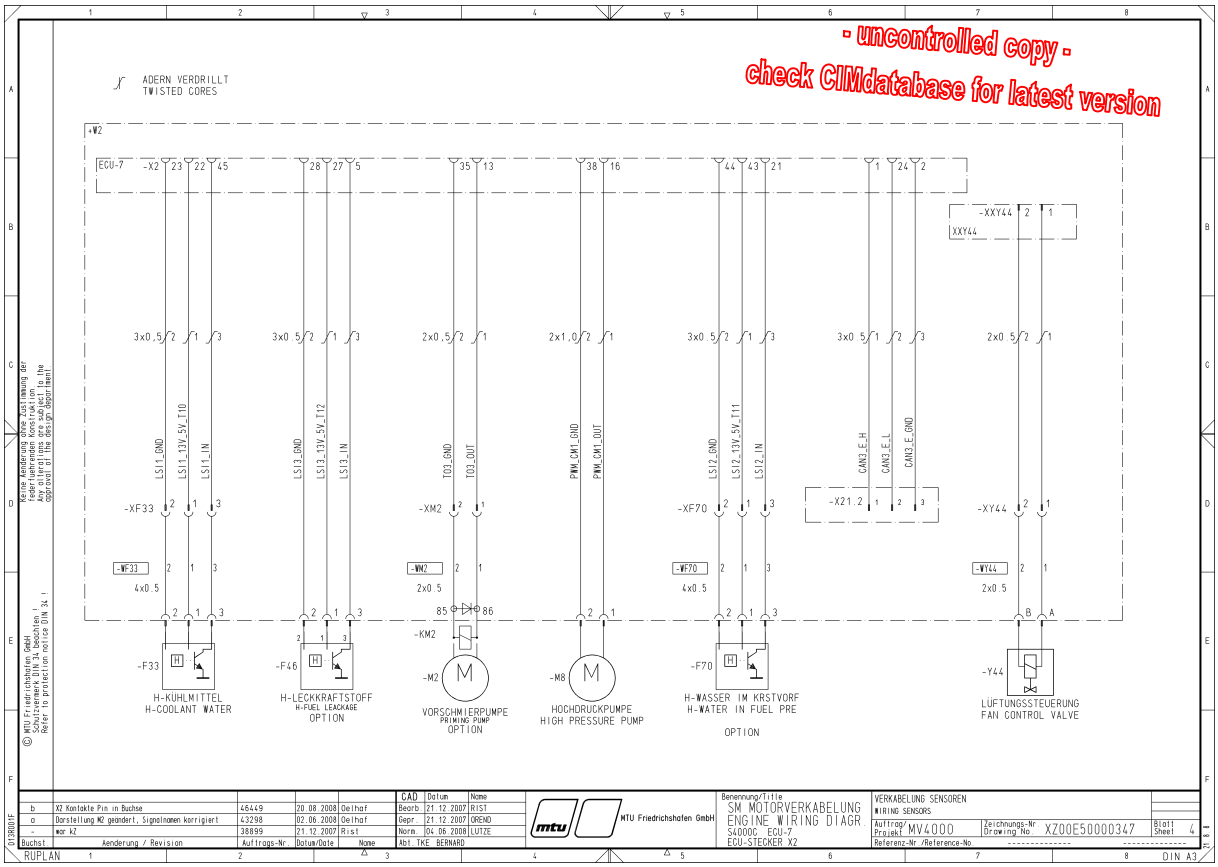
TOP4 - "Starter ON"	TOP4 activated	**YES**	Rule 3-0-2-4
	Wire break monitoring active	**NO**	Rule 3-0-1-1
	Active for bulb test (SAM B_IN2 - "Binary Output Test")	**NO**	Rule 3-2-1
	low side switch	**NO**	Rule 3-0-3-2
	normally open switch	**YES**	Rule 3-0-4-4

Attachment 2: I/O overview SAM



Attachment 3: Prelube pump

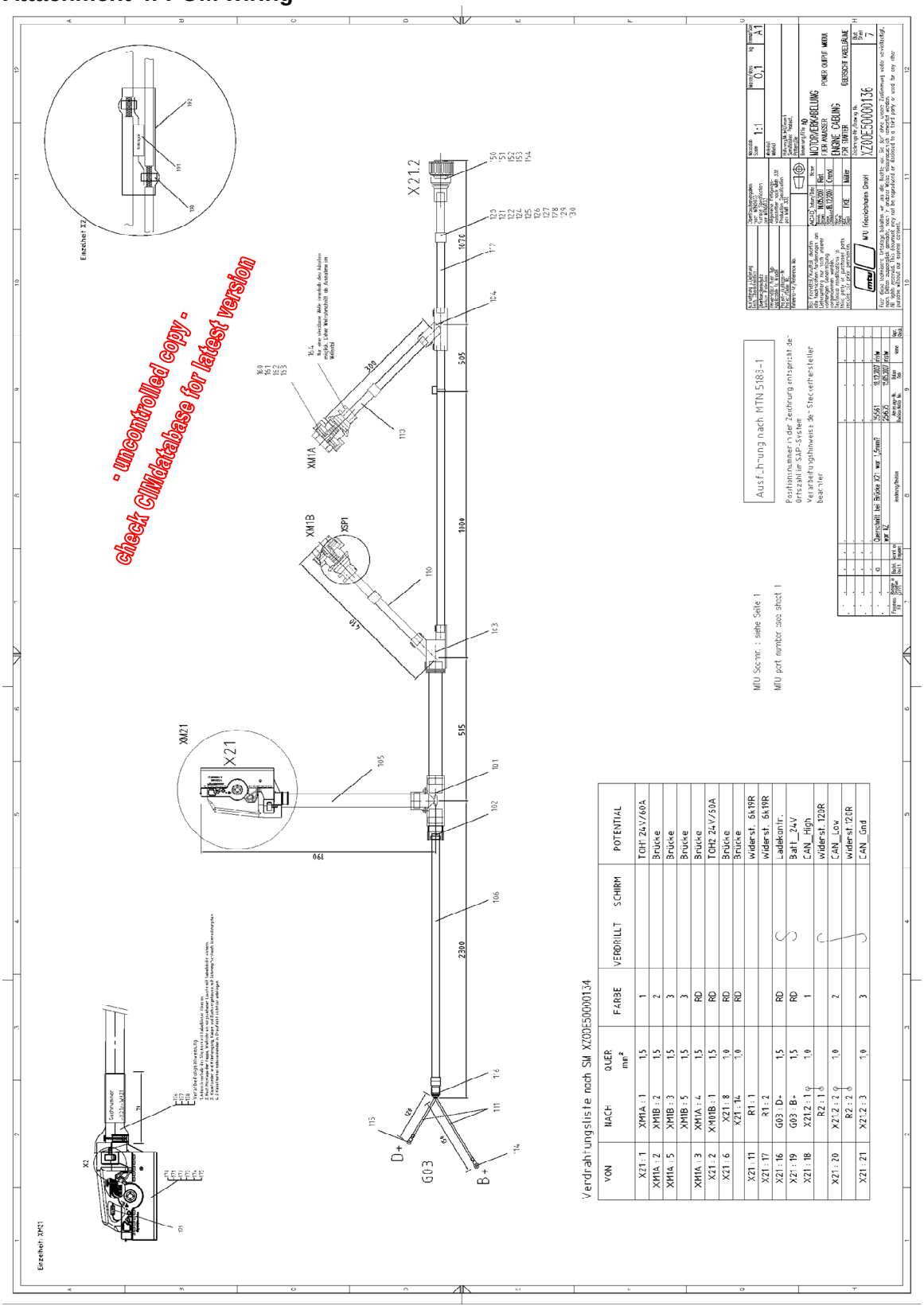
- Wiring



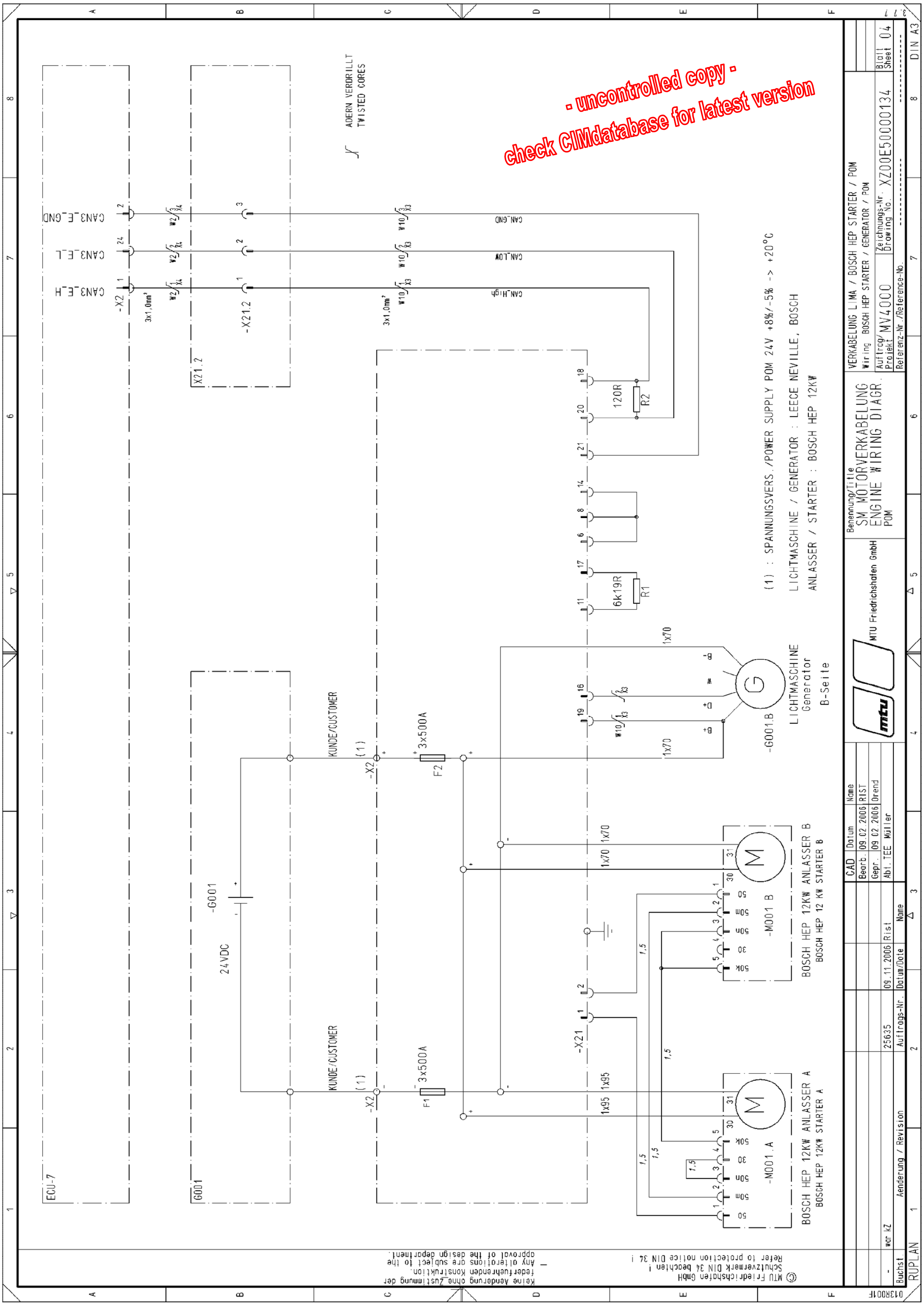
- ADEC parameters

Parameters:		w/o prelube	w/ prelube
1.1040.003	BinOut TO3 PV-Number	0	2.1090.014
1.1040.007	BinOut TO3 Active Level	0	0
1.1040.009	BinOut Monitoring Config.	0	4
1.8004.636	AL Wiring TO 3	1233	1233
2.1090.100	Enable Starting Procedure	1	1
2.1090.103	Enable Prelubrication on Start	0	1
2.1090.104	Enable Manual Prelubrication	0	0
2.1090.107	Enable Intermittent Oil Priming	0	0
2.1090.920	AL Prelubrication Fault	225	225

Attachment 4: POM wiring



VON	NACH	QUER mm²	FARBE	VERDRILLT	SCHIRM	POTENTIAL
X21:1	XM1A:1	1,5		1		TCH2 24V/60A
XM1A:2	XM1B:2	1,5		2		Brücke
XM1A:5	XM1B:3	1,5		3		Brücke
	XM1B:5	1,5		3		Brücke
XM1A:3	XM1A:4	1,5	RD			Brücke
X21:2	X40/B:1	1,5	RD			TCH2 24V/50A
X21:6	X21:8	1,0	RD			Brücke
	X21:14	1,0	RD			Brücke
X21:11	R1:1					widerst. 6kt9R
X21:17	R1:2					widerst. 6kt9R
X21:16	G03:D-	1,5	RD			Ladekontr.
X21:19	G03:B-	1,5	RD			Batt_24V
X21:18	X21.2:10	1,0	1			CAN_High
	R2:10					widerst. 120R
X21:20	X21.2:9	1,0	2			CAN_Low
	R2:2					widerst 120R
X21:21	X21.2:3	1,0	3			CAN_Gnd


- uncontrolled copy -
check CIMdatabase for latest version
CAN3_E_GND
CAN3_E_L
CAN3_E_H
ADERN VERDRILLT
TWISTED CORES
CAN_GND
CAN_LOW
CAN_High
120R
R2
6k19R
R1
LICHTMASCHINE
Generator
B-Seite
BOSCH HEP 12KW ANLASSER B
BOSCH HEP 12KW ANLASSER A
24VDC
KUNDE/CUSTOMER
3x500A
ECU-7
G001
X21.2
(1) : SPANNUNGSVERS./POWER SUPPLY POM 24V +8%/-5% -> +20°C
LICHTMASCHINE / GENERATOR : LEECE NEVILLE, BOSCH
ANLASSER / STARTER : BOSCH HEP 12KW
SM MOTORVERKABELUNG
ENGINE WIRING DIAGR.
POM
MTU Friedrichshafen GmbH
VERKABELUNG LIMA / BOSCH HEP STARTER / POM
Auftrag/ Projekt MV4000
Zeichnungs-Nr. Drawing No. XZ00E50000134

- ADEC parameters POM

Parameters:		w/o POM	w/ POM
1.4500.001	POM installed	0	1
1.4500.002	Monitoring Suppression/Engine stopped	0	0
1.4500.003	CAN POM Start Monitor Delay Time	4	4
1.4500.005	Starter Engaged Factor	1,3	1,3
1.4500.006	Starter Engaged Time Out	0,8	0,8
1.4500.051	U-Power Supply POM Lower Limit 1	18	18
1.4500.052	U-Power Supply POM Lower Limit 2	13	10
2.1050.004	BinOut TOP4 PV-Number	2.1090.013	0
2.1050.009	BinOut TOP Monitoring Configuration	3	3
2.1050.017	TOP4 Select for Test (Lamp)	0	0

Attachment 5: Start sequence ADEC